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Public Health Service
Washington, D. C.

June 1962

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations at urban locations operated by State and local health department personnel, except for 2 stations which were operated by Public Health Service personnel. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network was expanded over a period of a few months to 63 stations (see figure 1).

Air

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone.

Daily air samples are collected continuously by a high volume air sampler with a carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours afer collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network for a more refined measurement using a thin-window gas flow proportional counter. Table 1 presents the monthly summary report of fission-product gross beta concentrations in surface air during January 1962. The data shown represent the activities extrapolated to the time of collection.

Precipitation

Continuous sampling for total precipitation is conducted at each station on a daily basis using locally-made funnels having collection areas of 0.4 square meter (m^2). One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples.

The monthly averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$), are presented in tables 2 and 3 for December 1961 and January 1962 respectively. The total precipitation for the

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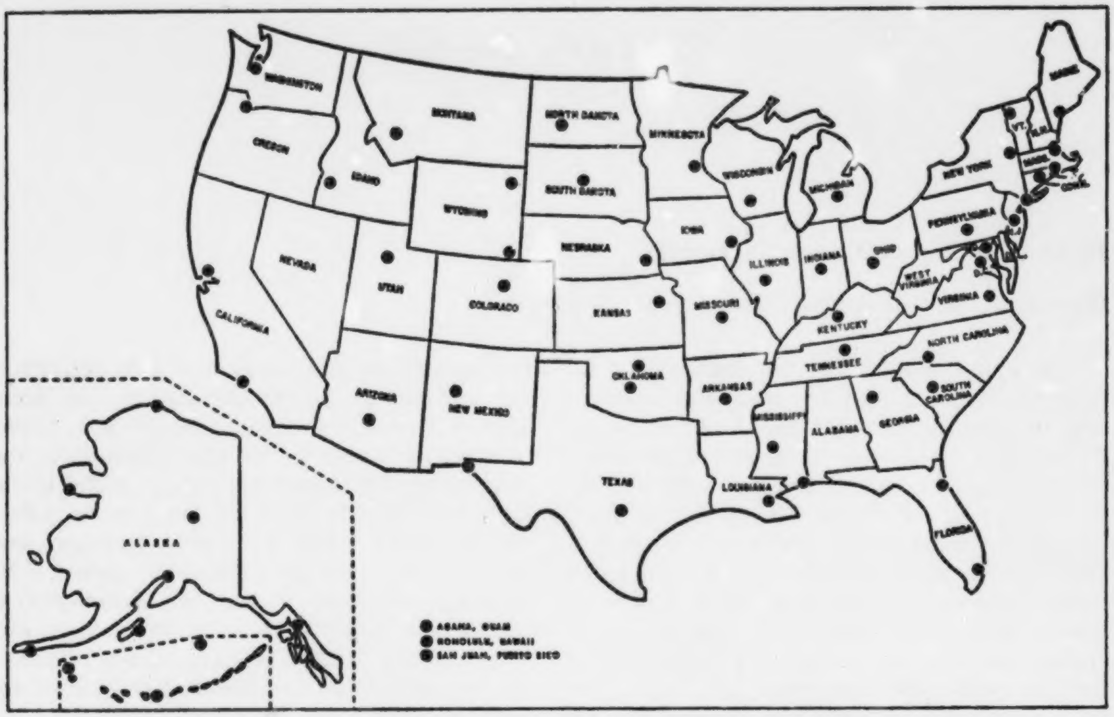
month, expressed in millimeters, may be computed directly from the data by using the following expression:

$$\text{Total precipitation (mm)} = \frac{\text{Total activity } (\mu\mu\text{c/m}^2)}{\text{Average concentration } (\mu\mu\text{c/liter})}$$

When the gross beta concentration of a given daily precipitation sample is too low for reliable measurement, an activity ($\mu\mu$c/m^2) calculated from the minimum level of detection is included in the monthly summation of activity. In the event that the sum of such "less-than" activities is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a less-than (<) sign.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TEXAS
LOUISIANA
FLORIDA
ALASKA
● AGANA, GUAM
● HONOLULU, HAWAII
● SAN JUAN, PUERTO RICO

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS, JANUARY 1962

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TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, JANUARY 1962

[Concentrations in μμc/m³]

Station location		Number samples	Maximum	Minimum	Average[1]
City	State				
Adak	Alaska	27	16	0.70	5.6
Anchorage	Alaska	27	18	1.1	6.2
Attu	Alaska	22	10	0.20	4.4
Cold Bay	Alaska	28	9.4	<0.10	4.5
Fairbanks	Alaska	19	7.6	2.0	4.2
Juneau	Alaska	24	10	0.25	5.2
Kodiak	Alaska	24	10	<0.10	4.4
Nome	Alaska	22	12	0.70	5.4
Point Barrow	Alaska	30	13	6.4	3.7
St. Paul Island	Alaska	8	7.7	1.6	4.3
Phoenix	Arizona	25	28	3.7	12
Little Rock	Arkansas	25	11	2.1	5.6
Berkeley	California	26	18	2.4	7.2
Los Angeles	California	24	24	4.3	12
Denver	Colorado	25	28	3.5	12
Hartford	Connecticut	27	10	1.5	5.8
Washington	D. C.	29	17	4.3	8.9
Jacksonville	Florida	28	20	3.1	8.0
Miami	Florida	28	16	2.3	8.5
Atlanta	Georgia	27	11	1.3	5.9
Agana	Guam	29	4.3	<0.10	2.2
Honolulu	Hawaii	28	5.8	1.4	3.2
Boise	Idaho	26	16	4.1	7.1
Springfield	Illinois	29	12	1.4	5.4
Indianapolis	Indiana	27	9.3	0.96	5.2
Iowa City	Iowa	26	11	3.0	6.0
Topeka	Kansas	25	10	2.8	5.7
Frankfort	Kentucky	25	16	2.6	8.0
New Orleans	Louisiana	25	16	2.9	6.6
Augusta	Maine	30	8.8	2.3	6.2
Baltimore	Maryland	27	15	3.2	8.1
Lawrence	Massachusetts	25	8.1	2.1	5.4
Lansing	Michigan	29	20	3.8	9.2
Minneapolis	Minnesota	26	9.0	2.8	4.7
Jackson	Mississippi	25	12	1.6	5.7
Pascagoula	Mississippi	21	15	2.2	7.5
Jefferson City	Missouri	26	12	2.4	5.2
Helena	Montana	24	11	3.3	6.1
Lincoln	Nebraska	3	10	8.2	9.2
Trenton	New Jersey	27	9.2	3.1	5.5
Santa Fe	New Mexico	24	19	1.5	10
Albany	New York	28	12	2.5	5.7
New York	New York	18	14	5.7	10
Gastonia	North Carolina	26	12	2.3	7.2
Bismarck	North Dakota	25	10	2.9	5.6
Columbus	Ohio	25	39	3.6	11
Oklahoma City	Oklahoma	26	15	3.3	8.4
Ponca City	Oklahoma	24	6.6	0.21	3.4
Portland	Oregon	26	19	1.8	8.1
Harrisburg	Pennsylvania	24	16	2.0	6.2
San Juan	Puerto Rico	15	8.0	2.1	4.1
Providence	Rhode Island	25	11	3.5	7.2
Columbia	South Carolina	23	11	2.3	5.8
Pierre	South Dakota	21	11	3.4	7.4
Nashville	Tennessee	29	13	0.88	6.7
Austin	Texas	26	9.0	2.0	5.8
El Paso	Texas	25	18	2.1	11
Salt Lake City	Utah	26	13	2.9	7.0
Richmond	Virginia	27	13	2.6	6.0
Seattle	Washington	23	8.6	<0.10	3.2
Madison	Wisconsin	26	14	4.0	7.0
Cheyenne	Wyoming	26	16	4.1	8.8
Sundance	Wyoming	5	11	5.0	9.4
Network average					6.7

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, DECEMBER 1961

Station location		Concentration (μμc/liter)	Activity (μμc/m²)
City	State		
Adak	Alaska	[a] —	—
Anchorage	Alaska	4,520	15,000
Attu	Alaska	—	—
Cold Bay	Alaska	—	—
Fairbanks	Alaska	1,960	28,000
Juneau	Alaska	1,480	166,000
Kodiak	Alaska	—	—
Nome	Alaska	—	—
Point Barrow	Alaska	—	—
St. Paul Island	Alaska	—	—
Phoenix	Ariz	—	—
Little Rock	Ark	440	27,300
Berkeley	Calif	386	19,000
Los Angeles	Calif	2,160	95,300
Denver	Colo	3,070	4,600
Hartford	Conn	2,910	170,000
Washington	D. C	1,160	84,000
Jacksonville	Fla	1,230	14,000
Miami	Fla	—	—
Atlanta	Ga	734	110,000
Agana	Guam	—	—
Honolulu	Hawaii	1,260	56,000
Boise	Idaho	1,520	37,000
Springfield	Ill	—	—
Indianapolis	Ind	4,450	340,000
Iowa City	Iowa	610	23,000
Topeka	Kans	4,630	20,000
Frankfort	Ky	—	—
New Orleans	La	725	140,000
Augusta	Maine	—	—
Baltimore	Md	—	—
Lawrence	Mass	2,380	37,000

Station location		Concentration (μμc/liter)	Activities (μμc/m²)
City	State		
Lansing	Mich	3,620	41,000
Minneapolis	Minn	2,840	39,000
Jackson	Miss	—	—
Pascagoula	Miss	<254	<20,000
Jefferson City	Mo	1,570	55,000
Helena	Mont	4,260	48,000
Lincoln	Nebr	—	—
Trenton	N. J	—	—
Santa Fe	N. M	3,100	86,400
Albany	N. Y	2,190	6,800
New York	N. Y	—	—
Gastonia	N. C	1,110	180,000
Bismarck	N. D	7,580	62,500
Columbus	Ohio	3,310	113,000
Oklahoma City	Okla	4,810	40,300
Ponca City	Okla	1,700	51,100
Portland	Oreg	2,020	205,000
Harrisburg	Pa	3,430	57,000
San Juan	P. R	540	39,000
Providence	R. I	7,050	110,000
Columbia	S. C	1,090	100,000
Pierre	S. D	1,400	74,000
Nashville	Tenn	2,890	46,000
Austin	Tex	576	16,000
El Paso	Tex	5,060	81,000
Salt Lake City	Utah	6,630	200,000
Richmond	Va	1,440	120,000
Seattle	Wash	2,230	150,000
Madison	Wis	1,580	25,900
Cheyenne	Wyo	511	9,700
Sundance	Wyo	—	—

[a] Dash denotes no sample received.

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TABLE 3.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, JANUARY 1962

Station location		Concentration (μμc/liter)	Activities (μμc/m²)
City	State		
Adak	Alaska	* —	—
Anchorage	Alaska	6,100	27,000
Attu	Alaska	—	—
Cold Bay	Alaska	—	—
Fairbanks	Alaska	1,920	32,000
Juneau	Alaska	3,200	690,000
Kodiak	Alaska	—	—
Nome	Alaska	—	—
Point Barrow	Alaska	—	—
St. Paul Island	Alaska	—	—
Phoenix	Ariz	—	—
Little Rock	Ark	1,370	300,000
Berkeley	Calif	1,530	66,000
Los Angeles	Calif	1,150	84,000
Denver	Colo	895	2,200
Hartford	Conn	2,610	160,000
Washington	D. C	811	30,000
Jacksonville	Fla	1,340	56,000
Atlanta	Ga	1,300	150,000
Honolulu	Hawaii	1,230	19,000
Boise	Idaho	7,0[illegible]	160,000
Springfield	Ill	90	5,400
Indianapolis	Ind	2,690	290,000
Iowa City	Iowa	901	33,000
Topeka	Kans	1,310	33,000
Frankfort	Ky	842	4,400
New Orleans	La	1,990	180,000
Augusta	Maine	1,540	100,000
Baltimore	Md	—	—
Lawrence	Mass	2,610	124,000
Lansing	Mich	2,670	130,000
Minneapolis	Minn	1,730	17,000
Jackson	Miss	1,050	300,000
Pascagoula	Miss	1,890	26,000
Jefferson City	Mo	1,300	49,000
Helena	Mont	707	8,500
Lincoln	Nebr	—	—
Trenton	N. J	—	—
Santa Fe	N. M	2,430	35,000
Albany	N. Y	1,290	65,000
New York	N. Y	—	—
Gastonia	N. C	1,470	220,000
Bismarck	N. D	1,010	8,300
Columbus	Ohio	2,160	140,000
Oklahoma City	Okla	189	1,800
Ponca City	Okla	2,400	18,000
Portland	Oreg	1,290	42,000
Harrisburg	Pa	3,780	31,000
San Juan	P. R	1,290	20,000
Providence	R. I	1,640	170,000
Columbia	S. C	1,640	280,000
Pierre	S. D	2,310	24,000
Nashville	Tenn	331	35,000
Austin	Tex	1,740	32,000
El Paso	Tex	1,380	27,000
Salt Lake City	Utah	2,260	36,000
Richmond	Va	770	110,000
Seattle	Wash	1,110	50,000
Madison	Wis	1,180	34,000
Cheyenne	Wyo	170	2,100
Sundance	Wyo	—	—
Agana	Guam	—	—

* Dash denotes no sample received.

Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air at Cincinnati, Ohio. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon-222 concentrations are determined from alpha measurements made immediately

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after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period January 2–January 26, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats, "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, 22, No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, JANUARY 2-26, 1962

End of sampling period	Continuous sample collection			Rn^{222} 8 a.m. (μμc/m³)	Rn^{222} 3 p.m.ª (μμc/m³)	Rn^{220} (μμc/m³)	Beta activity (μμc/m³)
	Sample change time	Sample period (hours)	Volume (m³)				
January 2	0815	94.4	113.8	190	220	0.7	4.34
3	0815	24.0	30.3	220	170	0.8	3.67
4	0800	23.7	29.4	120	130	1.1	11.35
5	0800	23.9	29.5	200	110	2.3	11.59
8	0800	71.9	89.8	110	100	0.7	10.46
9	0810	24.1	30.2	150	140	0.4	5.16
10	0800	23.8	30.4	160	140	0.4	5.95
11	0818	24.2	30.9	280	140	0.7	3.68
12	0810	23.8	29.9	310	110	0.5	4.63
15	0807	71.9	88.3	100	140	0.9	11.31
16	0809	24.0	29.9	110	60	0.4	6.99
17	0801	23.8	30.0	120	130	0.4	8.22
18	0801	23.9	30.1	150	140	0.4	9.49
19	0805	24.0	30.2	130	130	0.7	10.92
22	0801	71.9	88.3	80	190	0.6	10.24
23	0805	24.0	29.8	110	120	0.4	4.26
24	0800	23.9	29.5	180	140	1.1	8.03
25	0805	24.0	29.7	160	170	0.7	7.64
26	0807	24.0	29.6	300	30	1.8	5.25
Average				154	143	0.7	7.87
Range of counting errors (2σ)							
Maximum				30	25	0.5	0.21
Minimum				16	10	0.2	0.06

ª Sample period and volume does not apply to this column.

Radioactivity Measurements in Surface Air Near the 80th Meridian (West)

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 1. This program is operated by the U.S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile which have made the actual sample collections and forwarded them to NRL for analysis.

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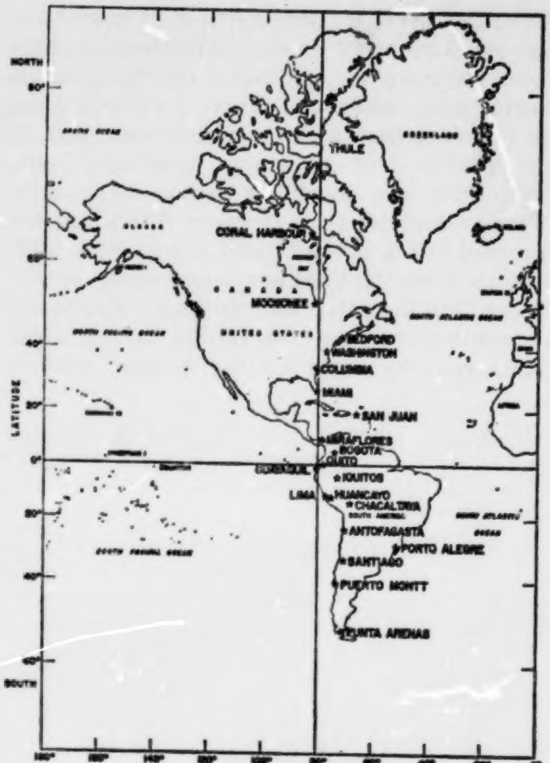
Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously at a rate of approximately 1200 cubic meters per day through high efficiency filters 8-inches in diameter, using positive displacement blowers. Due to the decrease of radioactivity levels during 1960 and 1961, it became necessary to change the sampling period from a daily to a weekly basis at most stations. After the sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

The daily record of fission product beta activity during December 1961 is presented in table 1, and the radioactivity profile along the 80th Meridian (West) for the same month is shown in figure 2. This figure illustrates the data plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air.

Radiochemical analyses are performed on monthly composite air-filter samples for the following nuclides: strontium-89, strontium-90, yttrium-91, cesium-137, cerium-141, cerium-144, promethium-147, tungsten-185, and lead-210. The 1960 analyses were reported in the March 1962 *Radiological Health Data*. The 1961 analyses will be reported in a future issue.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60°
40°
20°
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20°
40°
60°
SOUTH
LATITUDE
THULE
CORAL HARBOUR
CANADA
MOOSONEE
UNITED STATES
BEDFORD
WASHINGTON
COLUMBIA
MIAMI
SAN JUAN
MIRAFLORES
BOGOTA
QUITO
GUAYAQUIL
IQUITOS
LIMA
HUANCAYO
CHACALTAYA
ANTOFAGASTA
PORTO ALEGRE
SANTIAGO
PUERTO MONTT
PUNTA ARENAS
180°
160°
140°
120°
100°
80°
60°
40°
20°
0°
LONGITUDE WEST FROM GREENWICH

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN (WEST)

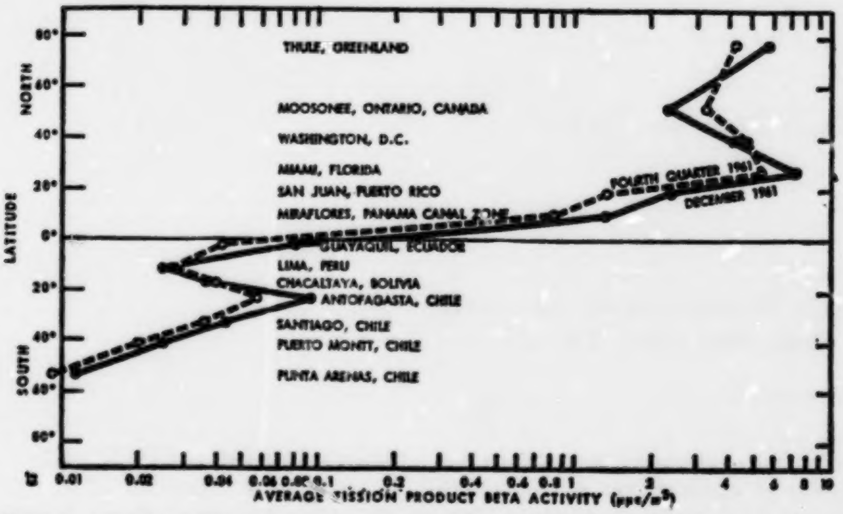

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN (WEST) FOURTH QUARTER AND DECEMBER 1961

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL, DECEMBER 1962[a]

[Disintegrations/minute per cubic meter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Canal Zone	San Juan, P. R.	Mauna Loa, Hawaii	Miami Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	....	0.045	....	0.187	0.151	0.061	0.110	0.66	3.50	10.9	20.6	11.1	4.23	14.5
2	....	0.045	....	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	4.23	14.5
3	....	0.045	....	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	5.08	14.5
4	....	0.045	....	0.187	0.151	0.061	0.110	0.60	3.50	10.9	20.6	11.1	5.08	14.5
5	0.027	0.058	....	0.135	0.152	0.026	0.110	2.01	6.03	5.86	15.4	12.0	4.92	14.5
6	0.027	0.058	....	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	5.04	10.9
7	0.027	0.058	....	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.60	10.9
8	0.027	0.058	....	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.74	10.9
9	0.027	0.058	....	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	4.16	10.9
10	0.027	0.058	....	0.135	0.152	0.026	0.126	2.01	6.03	5.86	15.4	12.0	3.36	10.9
11	0.027	0.058	....	0.135	0.152	0.026	....	2.01	6.03	5.86	15.4	12.0	3.75	10.9
12	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.54	10.9
13	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.79	13.8
14	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.77	13.8
15	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.42	13.8
16	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.55	13.8
17	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	3.40	13.8
18	....	0.071	0.120	0.169	0.022	0.014	0.123	3.17	7.48	6.93	9.35	7.09	4.60	13.8
19	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	6.72	13.8
20	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	7.06	13.1
21	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	5.36	13.1
22	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	10.6	13.1
23	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	5.93	13.1
24	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	6.21	13.1
25	0.019	0.050	0.094	0.256	0.034	0.065	0.213	4.54	6.03	7.26	17.6	7.90	9.38	13.1
26	0.037	0.050	0.086	0.275	0.088	0.065	0.295	4.65	2.76	12.5	21.6	9.20	11.2	13.1
27	0.037	....	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	9.06	....
28	0.037	....	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	2.18	....
29	0.037	....	0.086	0.275	0.088	0.151	0.295	4.65	2.70	12.5	21.6	9.20	3.11	....
30	0.037	....	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	3.08	....
31	0.037	....	0.086	0.275	0.088	0.151	0.295	4.65	2.76	12.5	21.6	9.20	4.35	....
Mean (dpm/m³)	0.027	0.057	0.101	0.204	0.083	0.058	0.177	3.17	5.40	8.35	16.4	9.31	5.21	13.0
Mean (μμc/m³)	0.012	0.026	0.045	0.092	0.037	0.026	0.080	1.43	2.43	3.76	7.39	4.19	2.35	5.86

[a] Continuous weekly samples were collected at all stations except Moosonee, Canada which collected continuous daily samples.
[b] Mauna Loa data has been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally distant north and south of the equator.

National Air Sampling Network

Division of Air Pollution, Public Health Service

The Public Health Service developed its National Air Sampling Network in 1953 to secure basic data on the nature and extent of air pollution throughout the United States, and to detect trends in levels of pollution with respect to time, location, population density, cimate, and other factors associated with air quality.

The current basic network consists of 103 sampling stations operating every year in 66 large cities and 37 nonurban areas. In addition to these every-year stations, 126 cities have stations which operate every other year. Thus, there are 229 sampling stations in all, of which about 166 are active in any given year. A list of National Air Sampling Network Stations appeared in the May 1960 issue of *Radiological Health Data*.

The network stations are manned by cooperating Federal, State, and local agencies. Twenty-four hour samples of suspended particulate matter representing approximately 2000 cubic meters of air are collected on glass fiber filters on a bi-weekly random sampling schedule. The analyses of these samples include the measurement of total quantity of suspended particulate matter, the organic matter soluble in benzene, and gross beta radioactivity. Selected samples are analyzed also for nitrates and sulfates, and for a number of metals.

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, FOURTH QUARTER 1961

[Concentrations in μμc/m³]

Station location	Number of samples	Minimum	Maximum	Average
Acadia Nat. Pk., Maine[1]	6	2.1	32.5	15.4
Akron, Ohio	6	8.3	30.8	15.7
Albany, N. Y	5	1.5	28.2	14.5
Albuquerque, N. Mex	6	6.2	25.0	14.7
Allentown, Pa	6	3.4	21.8	14.7
Anchorage, Alaska	5	4.3	27.7	11.1
Atlanta, Ga	6	6.4	12.3	8.2
Atlantic City, N. J	7	6.1	28.1	15.0
Augusta, Ga	6	4.3	48.8	14.9
Austin, Tex	7	5.6	36.1	24.1
Baltimore, Md	6	4.5	17.6	12.4
Beaumont, Tex	6	4.8	15.8	12.7
Berkeley, Calif	7	1.4	28.6	13.2
Bethlehem, Pa	7	2.2	25.7	10.8
Binghamton, N. Y	7	0.6	41.2	12.9
Birmingham, Ala	6	5.1	66.3	25.2
Bismarck, N. D	6	6.3	25.2	15.8
Boise, Idaho	6	1.7	13.5	8.3
Boston, Mass	6	4.6	19.6	10.5
Brockton, Mass	6	1.0	10.3	4.6
Burlington, Vt	6	3.4	10.3	6.9
Butte County, Idaho[1]	5	1.3	35.2	20.9
Calvert County, Md[1]	7	1.0	33.7	14.8
Cambridge, Mass	5	1.8	12.2	7.3
Canton, Ohio	6	1.6	28.8	12.4
Cape Hatteras, N. C.[1]	5	5.3	28.1	13.7
Cape Vincent, N. Y.[1]	6	3.0	18.3	9.7
Charleston, S. C	6	6.2	32.0	18.0
Charleston, W. Va	6	8.2	16.3	10.9
Charlotte, N. C	6	5.3	30.0	14.6
Chattanooga, Tenn	6	6.5	17.4	12.4
Cherokee County, Okla.[1]	6	2.9	31.5	17.7
Cheyenne, Wyo	5	8.4	40.6	20.2
Chicago, Ill	7	6.2	27.4	15.3
Cincinnati, Ohio	6	6.0	25.1	13.0
Clallam County, Wash.[1]	5	1.3	13.1	7.8
Clarion County, Pa.[1]	5	7.3	16.2	13.5
Clayton County, Iowa[1]	7	3.4	20.1	10.9
Cleveland, Ohio	5	1.5	40.6	16.1
Colfax County, N. Mex.[1]	5	3.7	41.0	21.1
Columbia, S. C	6	7.3	22.3	15.4
Columbus, Ohio	6	3.3	24.0	12.5
Coos County, N. H.[1]	5	3.0	17.6	10.2
Curry County, Oreg.[1]	4	1.8	16.6	9.4
Dallas, Tex	5	6.3	44.1	15.9
Davenport, Iowa	6	4.9	16.6	10.2
Dayton, Ohio	6	3.6	15.8	9.5
Dearborn, Mich	5	0.6	34.4	18.7
Denver, Colo	7	3.2	26.4	14.8
Des Moines, Iowa	6	3.9	14.7	9.1
Detroit, Mich	6	7.4	21.3	12.2
Door County, Wis.[1]	4	2.4	26.4	9.6
Duluth, Minn	6	5.9	31.7	13.2
East Chicago, Ind	7	7.4	15.4	10.0
East St. Louis, Ill	4	2.1	29.7	13.1
Elmira, N. Y	7	3.5	16.5	10.2
Erie, Pa	4	1.0	23.3	14.5
Eugene, Oreg	6	0.7	59.6	18.5
Flint, Mich	6	2.6	30.9	14.6
Florida Keys, Fla.[1]	6	1.4	16.2	8.6
Galveston, Tex	6	4.0	20.0	12.2
Glacier Nat. Pk., Mont.[1]	6	3.8	20.2	13.4
Glen Cove, N. Y	6	2.7	81.0	32.3
Glendale, Calif	6	5.7	73.7	24.7
Grand Canyon Pk., Ariz.[1]	6	3.2	41.0	20.6
Greensboro, N. C	7	5.1	31.8	17.3
Hamilton, Ohio	6	3.7	48.9	19.9
Hammond, Ind	6	3.9	14.9	10.9
Hampton, Va	7	1.0	28.9	11.4
Hartford, Conn	6	5.1	14.6	10.3
Helena, Mont	7	2.7	52.5	21.0
Honolulu, Hawaii	6	1.6	11.7	5.7
Houston, Tex	5	6.0	27.3	16.4
Humboldt County, Calif.[1]	5	1.8	25.4	8.5
Indianapolis, Ind	6	4.8	15.6	8.8
Jackson County, Miss.[1]	6	6.4	35.7	18.1
Jackson, Mich	7	2.4	22.2	12.2
Jackson, Miss	4	4.7	35.1	21.2
Jersey City, N. J	6	1.8	24.5	11.7
Johnstown, Pa	5	6.8	9.7	8.5
Kahaluu, Hawaii[1]	6	2.3	26.9	10.0
Kansas City, Mo	6	2.9	26.0	14.5
Kent County, Del.[1]	6	0.8	23.6	12.4
Knoxville, Tenn	6	2.6	17.9	10.3
Las Vegas, Nev	5	2.9	52.8	24.8
Little Rock, Ark	7	4.4	32.8	15.9
Long Beach, Calif	7	9.8	30.2	22.3
LoQuillo Mtns, P. R.[1]	6	0.1	16.4	4.4
Los Angeles, Calif	7	0.1	33.0	21.7
Louisville, Ky	4	2.5	37.4	15.5
Lowell, Mass	4	3.6	19.7	9.3
Madison, Wis	7	2.0	30.1	15.1
Manchester, N. H	5	4.7	21.1	11.0
Maricopa County, Ariz.[1]	6	2.5	108.0	34.3
Massena, N. Y	6	2.4	9.3	6.5
Medford, Oreg	5	0.4	10.9	5.0
Memphis, Tenn	5	2.8	32.8	16.8
Miami, Fla	6	2.3	62.6	20.9
Milwaukee, Wis	6	7.0	43.1	17.2
Minneapolis, Minn	6	2.2	18.9	7.9
Montezuma County, Colo.[1]	5	8.9	33.6	20.4
Montgomery Ala	6	2.1	37.4	13.0
Montgomery County, Ark.[1]	6	4.1	43.9	16.7
Montgomery County, Ind.[1]	6	3.0	21.3	10.8
Mt. Vernon, N. Y	7	1.5	45.9	15.8
Nashville, Tenn	6	3.4	75.6	24.7
New Albany, Ind	5	2.2	23.0	11.5
New Bedford, Mass	6	1.6	17.9	11.5
New Britain, Conn	6	2.8	19.7	10.8
New Haven, Conn	6	1.8	16.2	7.0
New Orleans, La	6	1.0	31.7	13.3
New Rochelle, N. Y	6	2.9	25.3	12.1
New York, N. Y	7	2.3	31.2	16.8
Newark, N. J	5	2.9	12.5	7.4
Niagara Falls, N. Y	2	2.4	13.5	8.0
Norfolk, Va	5	5.1	15.0	11.8
Oakland, Calif	7	4.2	26.2	12.6
Oklahoma City, Okla	5	1.7	38.2	20.3
Omaha, Neb	6	1.9	21.3	14.1
Orange County, Vt.[1]	6	2.1	19.6	7.8
Orlando, Fla	5	0.2	18.2	9.3
Pasadena, Calif	5	2.4	30.5	20.7
Paterson, N. J	3	5.0	44.5	24.6
Philadelphia, Pa	6	2.2	13.4	9.2
Phoenix, Ariz	6	6.1	80.1	31.6
Pittsburgh, Pa	6	2.4	43.5	14.0
Portland, Maine	6	2.8	11.6	4.9
Portland, Oregon	6	3.0	16.0	8.9
Portsmouth, Va	6	6.3	37.6	15.9
Providence, R. I	6	4.0	29.7	15.7
Pt. Woronzof, Alaska[1]	6	2.9	14.6	8.9
Raleigh, N. C	6	4.6	17.8	12.0
Richland County, S. C[1]	4	1.4	21.7	16.1
Richmond, Va	6	0.7	17.7	10.3
Roanoke, Va	7	5.0	60.3	19.1
Rochester, N. Y	6	2.3	36.9	16.3
Rockford, Ill	6	3.5	25.0	13.1
Salt Lake City, Utah	7	0.3	28.6	19.8
San Antonio, Tex	6	1.3	24.8	11.6
San Bernardino, Calif	6	1.9	68.0	24.1
San Diego, Calif	6	6.4	20.5	13.2
San Francisco, Calif	6	2.6	44.0	20.6
San Jose, Calif	6	6.9	35.1	14.3
San Juan, Puerto Rico	5	1.9	12.6	4.8
Savannah, Ga	6	7.6	51.2	20.2
Schenectady, N. Y	6	2.2	18.3	10.0
Scranton, Pa	6	1.1	30.9	14.1
Seattle, Wash	6	1.7	13.3	5.9
Shannon County, Mo.[1]	3	5.9	19.0	13.7
Shenandoah Nat. Pk., Va.[1]	6	7.6	63.4	22.5
Shreveport, La	6	4.8	69.2	23.8
Sioux Falls, S. D	6	2.5	28.0	15.1
South Bend, Ind	6	2.7	42.2	16.4
Spokane, Wash	5	4.8	23.2	13.2
St. Louis, Mo	6	1.9	21.0	10.2
St. Paul, Minn	6	2.5	18.6	10.1
St. Petersburg, Fla	6	2.2	36.8	20.0
Stockton, Calif	7	2.1	49.1	21.6
Syracuse, N. Y	6	6.0	15.6	9.6
Tampa, Fla	7	4.4	30.3	14.7
Terre Haute, Ind	6	1.2	26.4	9.5
Thomas County, Nebr.[1]	6	9.0	41.8	20.2
Topeka, Kans	3	0.8	22.3	15.8
Troy, N. Y	5	2.7	32.1	18.6
Tucson, Ariz	5	4.1	50.4	21.2
Tulsa, Okla	6	1.6	35.0	18.1
Utica, N. Y	6	4.2	14.6	9.1
Ward County, N. D.[1]	7	0.2	29.4	9.2
Washington County, R. I.[1]	5	4.3	17.9	10.1
Washington, D. C	6	0.2	38.2	16.7
Waterbury, Conn	4	2.0	18.3	11.1
Wheeling, W. Va	4	8.3	27.6	15.8
White Pine County, Nev.[1]	6	9.7	53.7	20.7
Wichita, Kans	7	4.8	14.9	9.9
Wilmington, Del	5	9.4	29.3	16.1
Worcester, Mass	6	2.4	24.6	12.5
Yellowstone Pk., Wyo.[1]	6	4.0	27.0	13.7
York, Pa	6	7.4	19.6	12.3
Youngstown, Ohio	6	3.4	19.5	12.9

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[1] Nonurban station.

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NASN, ANNUAL SUMMARY, 1961

[Concentrations in $\mu\mu c/m^3$]

Station location	Number of samples	Minimum	Maximum	Average
Acadia Nat. Pk., Maine[1]	25	<0.1	32.5	4.1
Akron, Ohio	26	<0.1	30.8	3.7
Albany, N. Y	22	<0.1	28.2	4.2
Albuquerque, N. Mex	22	0.1	25.0	4.1
Allentown, Pa	25	<0.1	21.8	4.8
Anchorage, Alaska	25	<0.1	27.7	2.8
Atlanta, Ga	23	<0.1	12.3	2.2
Atlantic City, N. J	26	<0.1	28.1	4.1
Augusta, Ga	26	<0.1	48.8	4.1
Austin, Tex	26	<0.1	36.1	6.6
Baltimore, Md	26	<0.1	17.6	3.1
Beaumont, Tex	25	<0.1	15.8	3.1
Berkeley, Calif	26	<0.1	28.6	4.6
Bethlehem, Pa	25	<0.1	25.7	3.1
Binghamton, N. Y	26	<0.1	41.2	3.6
Birmingham, Ala	26	<0.1	58.3	6.3
Bismarck, N. D	25	<0.1	35.2	4.1
Boise, Idaho	26	<0.1	14.3	2.9
Boston, Mass	24	<0.1	19.6	2.7
Brockton, Mass	26	<0.1	11.0	1.6
Burlington, Vt	24	<0.1	10.3	1.8
Butte County, Idaho[1]	23	<0.1	35.2	4.8
Calvert County, Md.[1]	25	[illegible]	23.7	4.2
Cambridge, Mass	24	<0.1	53.0	3.9
Canton, Ohio	26	<0.1	28.8	3.3
Cape Hatteras, N. C.[1]	24	<0.1	31.0	4.6
Cape Vincent, N. Y.[1]	25	<0.1	18.3	2.7
Charleston, S. C	25	<0.1	32.0	6.0
Charleston, W. Va	26	<0.1	16.3	2.8
Charlotte, N. C	26	<0.1	39.0	3.7
Chattanooga, Tenn	26	<0.1	17.4	3.3
Cherokee County, Okla.[1]	25	<0.1	31.5	4.7
Cheyenne, Wyo	25	<0.1	46.2	6.2
Chicago, Ill	26	<0.1	27.4	4.2
Cincinnato, Ohio	25	<0.1	25.1	3.5
Clallam County, Wash.[1]	21	<0.1	13.1	2.0
Clarion County, Pa.[1]	23	<0.1	16.[illegible]	3.3
Clayton County, Iowa[1]	24	<0.1	20.1	3.8
Cleveland, Ohio	24	<0.1	40.6	4.7
Colfax County, N. Mex.[1]	21	<0.1	41.0	5.1
Columbia, S. C	24	<0.1	22.3	4.5
Columbus, Ohio	26	<0.1	63.9	5.5
Coos County, N. H.[1]	23	<0.1	23.1	3.8
Dallas, Texas	20	<0.1	44.1	4.1
Davenport, Iowa	23	<0.1	16.6	3.5
Dayton, Ohio	24	<0.1	15.8	2.6
Dearborn, Mich	22	<0.1	34.4	5.6
Denver, Colo	25	<0.1	26.4	4.3
Des Moines, Iowa	24	<0.1	14.7	2.8
Detroit, Mich	26	<0.1	36.1	4.3
Duluth, Minn	25	<0.1	31.7	3.6
East Chicago, Ind	24	<0.1	15.4	3.6
East St. Louis, Ill	23	<0.1	29.7	2.3
Elmira, N. Y	25	<0.1	16.5	2.9
Erie, Pa	22	<0.1	23.3	2.7
Eugene, Oreg	22	<0.1	59.6	5.1
Flint, Mich	20	0.1	30.9	5.1
Florida Keys, Fla.[1]	25	<0.1	16.2	2.4
Galveston, Tex	26	<0.1	20.0	3.2
Glacier Nat. Pk, Mont.[1]	25	<0.1	20.2	3.9
Glen Cove, N. Y	25	<0.1	81.0	8.5
Glendale, Calif	24	<0.1	73.7	6.6
Grand Canyon Pk., Ariz.[1]	25	<0.1	41.0	5.4
Greensboro, N. C	26	<0.1	31.8	4.7
Hamilton, Ohio	26	<0.1	48.9	5.0
Hammond, Ind	26	<0.1	14.9	3.0
Hampton, Va	26	<0.1	28.9	3.2
Hartford, Conn	23	<0.1	14.6	3.0
Helena, Mont	25	<0.1	52.5	6.0
Honolulu, Hawaii	25	<0.1	11.7	1.6
Houston, Tex	24	<0.1	27.3	3.9
Humboldt County, Calif.[1]	23	<0.1	25.4	2.5
Indianapolis, Ind	24	<0.1	15.6	2.3
Jackson County, Miss.[1]	20	<0.1	247.9	17.9
Jackson, Mich	26	<0.1	22.2	3.5
Jackson, Miss	20	<0.1	35.1	4.4
Jersey City, N. J	23	<0.1	24.5	4.0
Johnstown, Pa	22	<0.1	9.7	2.7
Kahaluu, Hawaii[1]	26	<0.1	26.9	2.5
Kansas City, Mo	24	<0.1	26.0	4.1
Kent County, Del.[1]	22	<0.1	23.6	3.8
Knoxville, Tenn	23	<0.1	17.9	3.3
Las Vegas, Nev	23	<0.1	53.0	7.8
Little Rock, Ark	25	<0.1	32.8	4.5
Long Beach, Calif	26	<0.1	30.2	6.2
Loquillo Mtns., P. R.[1]	26	<0.1	16.4	1.1
Los Angeles, Calif	26	<0.1	33.0	6.3
Louisville, Ky	21	<0.1	37.4	3.4
Lowell, Mass	21	<0.1	24.4	3.0
Madison, Wis	26	<0.1	39.1	5.6
Manchester, N. H	21	<0.1	21.1	3.8
Maricopa County, Ariz.[1]	26	<0.1	108.0	8.5
Massena, N. Y	25	<0.1	9.3	1.9
Medford, Oreg	22	<0.1	46.0	3.6
Memphis, Tenn	25	<0.1	32.8	3.7
Miami, Fla	26	<0.1	62.6	5.3
Milwaukee, Wis	23	<0.1	43.1	5.0
Minneapolis, Minn	26	<0.1	18.9	2.5
Montezuma County, Colo.[1]	25	<0.1	33.6	5.6
Montgomery, Ala	26	<0.1	37.4	3.4
Montgomery County, Ark.[1]	24	<0.1	43.9	4.2
Montgomery County, Ind.[1]	26	<0.1	21.3	3.0
Mt. Vernon, N. Y	24	<0.1	45.9	4.7
Nashville, Tenn	25	<0.1	75.6	6.4
New Albany, Ind	20	<0.1	23.0	3.1
New Bedford, Mass	25	<0.1	43.6	4.9
New Britain, Conn	22	<0.1	19.7	3.0
New Haven, Conn	26	<0.1	16.2	2.3
New Orleans, La	26	<0.1	31.7	3.6
New Rochelle, N. Y	23	<0.1	26.3	3.2
New York, N. Y	26	<0.1	31.2	4.6
Newark, N. J	25	<0.1	13.5	1.7
Norfolk, Va	25	<0.1	15.0	2.7
Oakland, Calif	23	<0.1	26.2	4.1
Oklahoma City, Okla	25	<0.1	263.7	14.1
Omaha, Nebr	26	<0.1	21.3	3.5
Orange County, Vt.[1]	25	<0.1	19.6	3.3
Orlando, Fla	21	<0.1	18.2	3.1
Philadelphia, Pa	26	<0.1	13.4	2.4
Phoenix, Ariz	26	<0.1	80.1	8.2
Pittsburgh, Pa	25	0.1	42.5	3.6
Portland, Maine	26	<0.1	11.6	1.3
Portland, Oreg	26	<0.1	16.0	2.4
Portsmouth, Va	24	<0.1	75.0	7.9
Providence, R. I	25	<0.1	29.7	3.9
Pt. Woronzof, Alaska[1]	26	<0.1	14.6	2.3
Raleigh, N. C	24	<0.1	17.8	3.5
Richland County, S. C.[1]	23	<0.1	21.7	3.4
Richmond, Va	24	<0.1	21.8	3.6
Roanoke, Va	26	<0.1	60.3	5.2
Rochester, N. Y	26	<0.1	36.9	3.9
Rockford, Ill	26	<0.1	25.0	3.4
Salt Lake City, Utah	22	<0.1	28.6	7.8
San Antonio, Tex	22	<0.1	227.7	14.2
San Bernardino, Calif	25	<0.1	58.0	6.3
San Diego, Calif	24	<0.1	20.5	3.8
San Francisco, Calif	25	<0.1	44.0	5.1
San Jose, Calif	26	<0.1	35.1	3.9
San Juan, Puerto Rico	24	<0.1	12.6	1.2
Savannah, Ga	26	<0.1	51.2	5.2
Scranton, Pa	26	<0.1	30.9	3.5
Seattle, Wash	25	<0.1	13.3	1.7
Shannon County, Mo.[1]	21	<0.1	19.0	2.4
Shenandoah Nat. Pk., Va.[1]	24	<0.1	63.4	6.4
Shreveport, La	24	<0.1	262.9	17.1
Sioux Falls, S. D	26	<0.1	28.0	4.2
South Bend, Ind	26	<0.1	42.2	4.2
Spokane, Wash	25	<0.1	23.2	3.2
St. Louis, Mo	26	<0.1	21.0	3.0
St. Paul, Minn	26	<0.1	18.6	2.9
St. Petersburg, Fla	25	<0.1	36.8	6.1
Syracuse, N. Y	26	<0.1	15.6	2.5
Tampa, Fla	26	<0.1	30.3	4.0
Terre Haute, Ind	25	<0.1	26.4	2.7
Thomas County, Nebr.[1]	26	<0.1	41.8	5.1
Topeka, Kans	23	<0.1	22.3	2.7
Troy, N. Y	23	<0.1	45.4	6.1
Tucson, Ariz	23	<0.1	50.4	4.7
Tulsa, Okla	22	<0.1	35.0	5.6
Utica, N. Y	24	<0.1	14.6	2.9
Ward County, N. D.[1]	24	<0.1	29.4	3.0
Washington County, R. I.[1]	24	<0.1	17.9	2.4
Washington, D. C	23	<0.1	38.2	4.4
Waterbury, Conn	22	<0.1	44.1	4.1
White Pine County, Nev.[1]	25	<0.1	53.7	5.0
Wichita, Kans	24	<0.1	14.9	3.0
Wilmington, Del	23	<0.1	29.3	3.6
Worcester, Mass	26	<0.1	24.6	3.8
Yellowstone Pk., Wyo.[1]	26	<0.1	27.0	4.2
York, Pa	26	<0.1	46.5	4.9
Youngstown, Ohio	26	<0.1	19.5	3.1

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[1] Nonurban station.

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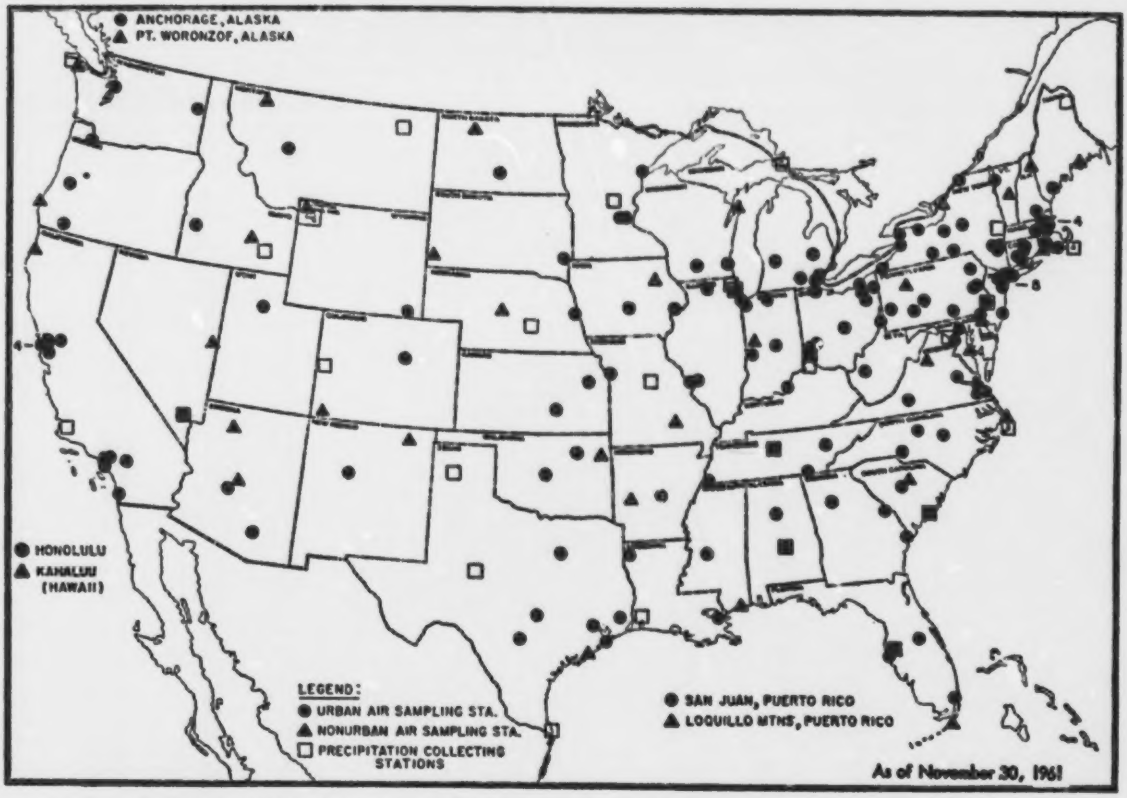
● ANCHORAGE, ALASKA
▲ PT. WORONZOF, ALASKA
● HONOLULU
▲ KAHALUU (HAWAII)
4
4
8
LEGEND:
● URBAN AIR SAMPLING STA.
▲ NONURBAN AIR SAMPLING STA.
□ PRECIPITATION COLLECTING STATIONS
● SAN JUAN, PUERTO RICO
▲ LOQUILLO MTNS, PUERTO RICO
As of November 30, 1961

FIGURE 1.—NATIONAL AIR SAMPLING NETWORK SAMPLING STATIONS, 1961

Quarterly reports of individual sample data and annual summaries are distributed to all participating agencies and state health departments.

Gross Beta Activity in Air

Gross beta activity data by states, for the years 1953 through 1958 were submitted by the Chief, Division of Radiological Health, Public Health Service, in testimony before the Joint Committee on Atomic Energy Hearing on Fallout from Nuclear Weapons Tests, Volume I, May 1959, pages 173–185. Subsequent data have been published quarterly in *Radiological Health Data* beginning with the October 1960 issue.

The fourth quarter data and the annual summary 1961 are presented in tables 1 and 2.

Due to an increased local interest in fallout following the resumption of nuclear weapons testing by the U.S.S.R., a large number of network stations stepped up their sampling programs. During the period of September through December 1961, 77 stations submitted special samples for radioactivity measurements. Results from these special samples were reported to all network participants on a monthly basis.

Gross Beta Activity in Precipitation

During 1959 a precipitation collection and analysis program was established by the Weather Bureau Research Station in Cincin-

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nati, Ohio, and the National Air Sampling Network. The collection stations are located at Weather Bureau offices or airport stations. Monthly composite samples of precipitation are collected at 30 stations (see figure 1) and forwarded to the Network laboratory for analysis. A list of these precipitation collection stations is given below. Samples are analyzed for total solids and a large number of metals and nonmetals. In addition, samples representing 85 percent or more of the total precipitation recorded at the collecting stations are analyzed for fission product gross beta radioactivity if a large enough volume remains after the requirements for the chemical analysis have been met. Data for the Fourth Quarter 1961 appear in table 3. Previous data appeared in Volume I, Nos. 7 and 8; Volume II, Nos. 1, 4, 7, and 10; and Volume III, No. 1.

REFERENCE

Setter, L. R., Zimmer, C. E., Licking, D. S., and Tabor, E. C., "Air-Borne Particulate Beta Radioactivity Measurements of the National Air Sampling Network, 1953–1959," *American Industrial Hygiene Association Journal*, *22*, No. 3, June 1961.

PRECIPITATION COLLECTION STATIONS

Alabama: Montgomery
California: Santa Maria
Colorado: Grand Junction
Florida: Tampa
Idaho: Pocatello
Illinois:
  Chicago (Midway Airport)
  Chicago (O'Hare Airport)
Louisiana: Lake Charles
Maine: Caribou
Maryland: Silver Hill
Massachusetts: Nantucket
Michigan: Sault Ste. Marie
Minnesota: St. Cloud
Missouri: Columbia
Montana: Glasgow
Nebraska: Grand Island
Nevada: Las Vegas
New York: Albany
North Carolina: Cape Hatteras
Ohio:
  Cincinnati (research station)
  Cincinnati (airport)
Pennsylvania: Philadelphia
South Carolina:
  Charleston
  Greenville
Tennessee: Nashville
Texas:
  Brownsville
  San Angelo
  Amarillo
Virginia: Sterling
Washington: Tatoosh Island

TABLE 3.—FISSION PRODUCT GROSS BETA ACTIVITY IN PRECIPITATION, NASN, FOURTH QUARTER 1961

Station	October		November		December	
	μμc/liter	μμc/m²	μμc/liter	μμc/m²	μμc/liter	μμc/m²
Albany, N. Y.	....	....	1040	91,900	....	....
Chicago, Ill. (Midway)	1040	65,000	....	....	2400	186,000
Chicago, Ill. (O'Hare)	431	34,900	....	....	....	....
Columbia, Mo.	578	36,000	436	28,400	....	....
Greenville, S. C.	....	....	449	37,000	331	79,700
Lake Charles, La.	....	....	66	20,800	....	....
Montgomery, Ala.	....	....	509	27,300	281	80,900
Nantucket, Mass.	171	18,000	503	26,300	525	34,300
Nashville, Tenn.	....	....	722	55,300	461	52,700
Philadelphia, Pa.	....	....	....	....	1160	96,000
Sault St. Marie, Mich.	....	....	....	....	706	90,700
St. Cloud, Minn.	637	33,100	....	....	....	....
Sterling, Va. (Washington, D. C.)	734	22,000	701	42,600	670	43,300
Tampa, Fla.	....	....	....	....	226	13,700
Tatoosh Island, Wash.	569	100,000	634	142,0 0	727	131,000

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SECTION II.—FOOD

Survey of Radioactivity in Food

Food and Drug Administration

The Food and Drug Administration conducts a continuing surveillance to determine the concentrations of certain radionuclides in a variety of different food items, domestic and foreign, as well as animal feeds and other items that may be of importance in the food chain. The data on the animal feeds are presented in the "Other Data" section of this issue. The following tabulations present the results of surveillance of foods for strontium-90. These samples were collected by representatives of the Food and Drug Administration districts.

Prior data from this survey has been presented in the May 1960, and January, August, September, and December 1961 *Radiological Health Data*. In table 1 are assembled additional strontium-90 analyses for 1960 and early 1961. A limited number of items—carrots, spinach, tomatoes, and wheat—are coded with letters in parentheses indicating that several items are from the same lot. By comparing raw and processed items from the same lot, changes in strontium-90 concentrations resulting from the processes of freezing, canning, and milling may generally be noted. Tea continues to show relatively high strontium-90 content in the original leaf form. [*Editor's note: The calculated strontium-90 content of an extract prepared from 2 grams of tea leaves containing the maximum Sr^{90} concentration reported in table 1 (1163 μμc/kg) would be 0.5 μμc/cup or 2 μμc/liter, when a conservative extraction factor of 0.2 is applied.*]

Table 2 presents some results of analyses for strontium-90 content of poultry bones and eggs. These data indicate that strontium-90 concentrations in bones of the older animals are higher than those of the younger animals. Taking the average of the high values (133 μμc/kg) and assuming a calcium content of 20 percent for wet bone, it can be calculated that bone contains 0.67 μμc Sr^{90} per gram of calcium (strontium units). It is interesting to note that the sample of egg shell has a strontium-90 content of the same order as bone.

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TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin		Date harvested or processed	Sr^{90}
		County	State or country		
Vegetables	Lettuce		Wash.		0.72
	Lettuce		Wash.		0.99
	Lettuce	Macomb	Mich.	August 15, 1960	3.5
	Lettuce	Huron	Mich.	August 16, 1960	17
	Lettuce	Huron	Mich.	August 16, 1960	14
	Lettuce	Stark	Ohio	August 17, 1960	4.5
	Lettuce	Denver	Colo.	February 1961	0.3
	Spinach, fresh (a)[1]		Wash.	Spring 1961	5.7
	Spinach, frozen (a)		Wash.	Spring 1961	8.5
	Spinach, fresh (b)		Wash.	Spring 1961	6.0
	Spinach, frozen (b)		Wash.	Spring 1961	9.0
	Spinach, fresh (c)		Wash.	Spring 1961	9.2
	Spinach, frozen (c)		Wash.	Spring 1961	8.9
	Spinach, fresh (d)	Genesee	N. Y.	October 4, 1960	2.9
	Spinach, frozen (d)	Genesee	N. Y.	October 4, 1960	3.6
	Cabbage	Johnson	Kansas	June 19, 1961	6.0
	Cabbage	Weld	Colo.	September 8, 1960	2.7
	Cabbage	Lapeer & St. Clair	Mich.	September 28, 1960	1.6
	Celery	Middlesex	Mass.	September 28, 1960	16
	Celery	Huron	Ohio	August 16, 1960	19
	Celery	Van Buren	Mich.	July, September 1960	3.6
	Celery	Kent	Mich.	August, September 1960	2.8
	Celery	Ottawa	Mich.	July, October 1960	6.3
	Celery	Lapeer	Mich.	September 26, 1960	17
	Celery	Orange	Calif.	January 29, 1961	7.5
	Onions	Huron	Ohio	September 10, 1960	2.1
	Onions	Lorain	Ohio	September 1960	2.0
	Onions	Newaygo	Mich.	September 1960	2.7
	Onions	Mason	Mich.	September 1960	2.6
	Onions	Newaygo	Mich.	September 1960	8.4
	Onions	Marion	Oreg.	September 1960	0.71
	Onions	Grant	Wash.	September 1960	1.1
	Onions	Grant	Wash.	September 1960	1.7
	Onions	Delta	Colo.	September 1960	1.3
	Onions	Monterey	Calif.	September 1960	0.81
	Onions	Bernalillo	N. Mex.	October 1960	1.9
	Onions	Wayne	N. Y.	September 1960	0.71
	Onions	Warren	N. J.	August, September 1960	1.1
	Onions	Warren	N. J.	September 1960	0.05
	Carrots, fresh (e)	Ontario	N. Y.	November 1960	4.7
	Carrots, canned (e)	Ontario	N. Y.	November 1960	2.7
	Carrots, fresh (f)	Genesee	N. Y.	October 1960	8.8
	Carrots, canned (f)	Genesee	N. Y.	October 1960	7.9
	Carrots, fresh (g)	Cass	Mich.	October 1960	2.7
	Carrots, canned (g)	Cass	Mich.	October 1960	1.3
	Carrots, fresh	Dona Ana	N. Mex.	October 1960	1.3
	Carrots, fresh	Costilla	Colo.	September 1960	2.1
	Carrots, fresh	Parmer	Tex.	October 1960	5.1
	Green beans, raw (h)	Mercer	Ohio	September 26, 1960	2.4
	Green beans, canned (h)	Mercer	Ohio	September 26, 1960	0.74
	Green beans, raw (i)	Ashe	N. C.	September 1960	16
	Green beans, canned (i)	Ashe	N. C.	September 1960	13
	Green beans, raw (j)	Hidalgo	Tex.	October 16, 1960	3.9
	Green beans, canned (j)	Hidalgo	Tex.	October 16, 1960	0.53
	Green beans, raw (k)	Wayne	N. Y.	September 22, 1960	36
	Green beans, canned (k)	Wayne	N. Y.	September 22, 1960	23
	Green beans, raw (l)	Santa Cruz	Calif.	September 15, 1960	11
	Green beans, canned (l)	Santa Cruz	Calif.	September 15, 1960	20
	Soybeans	Baltimore	Md.	Late 1960	81
	Soybeans	Peach	Ga.	October, November 1960	145
	Soybeans	Clinton	Ohio	1960	13
	Soybeans	Wayne	N. Y.	1960	24
	Soybeans	Leavenworth	Kans.	1960	31
	Soybeans	Hale	Tex.	November 1960	14
	Peas, dried	Whitman	Wash.	July 1960	5.4
Fruits	Tomatoes, fresh, (m)	Darke	Ohio	1960	1.2
	Tomatoes, canned (m)	Darke	Ohio	1960	0.25
	Tomatoes, fresh (n)	Sandusky	Ohio	September 1, 1960	0.50
	Tomatoes, canned (n)	Sandusky	Ohio	September 1, 1960	2.1
	Tomatoes, canned	Madison	Ind.	September 14, 1960	0.36
	Tomatoes, canned	San Joaquin	Calif.	September 15, 1960	1.6
	Tomatoes, fresh (o)	Davis	Utah	September 7, 1960	0.78
	Tomatoes, canned (o)	Davis	Utah	September 7, 1960	1.3
	Tomatoes, fresh (p)	Wayne	N. Y.	September 23, 1960	2.8
	Tomatoes, canned (p)	Wayne	N. Y.	September 23, 1960	0.21
	Tomatoes, fresh	Henry	Ind.	September 22, 1960	1.3
	Tomatoes, fresh (q)	Adair	Okla.	August 16, 1960	1.74
	Tomatoes, canned (q)	Adair	Okla.	August 16, 1960	2.5
	Tomatoes, fresh (r)	Adair	Okla.	August 16, 1960	0.34
	Tomatoes, canned (r)	Adair	Okla.	August 16, 1960	2.2
	Tomatoes, fresh (s)	Westmoreland	Va.	August 25, 1960	3.4
	Tomatoes, canned (s)	Westmoreland	Va.	August 25, 1960	1.9
	Peaches, peeled pitted	Benzie	Mich.	August 30, 1960	0.51

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[1] Code letters in parentheses indicate items from same product lot, i.e., frozen spinach (a) obtained from Washington State fresh spinach (a).

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS—Continued

[Concentrations in $\mu\mu c$/kg original material]

Category	Product	Origin		Date harvested or processed	Sr^{90}
		County	State or country		
Fruits—Continued	Apples, whole	Hood River	Oreg.	October 1960	0.22
	Apples, whole	Chelan	Wash.	October 1960	2.8
	Raisins	Madera	Calif.	August 25, 1960	5.2
	Raisins	Madera	Calif.	August 25, 1960	4.2
	Raisins	Fresno	Calif.	August 15, 1960	8.8
	Strawberries	Santa Cruz	Calif.	November 1, 1960	1.1
	Cranberries	Vilas	Wisc.	Fall 1960	3.6
Nuts	Cashew		Bombay, India	1960	0.79
	Cashew		S. India	1960	3.6
	Cashew		Brazil	1960	4.0
	Brazil		Brazil	1960	18
	Walnuts	Marion	Oreg.	Fall 1960	9.3
	Pecans	Lincoln	Okla.	1960	11
	Pecans	Orangeburg	S. C.	Fall 1960	12
	Pecans	Montgomery	Ala.	November 1960	17
	Almonds	San Joaquin	Calif.	October 15, 1960	19
	Almonds	Contra Costa	Calif.	October 15, 1960	7.8
	Almonds	Stanislaus	Calif.	October 15, 1960	8.9
	Almonds	Colusa	Calif.	Fall 1960	6.6
	Almonds	Colusa	Calif.	Fall 1960	5.9
	Almonds	Colusa	Calif.	Fall 1960	10.9
Coffee beans, cocoa beans and tea	Black tea leaves		Mozambique	January–March 1961	15
	Black tea leaves		Nyasaland	November, December 1960	56
	Black tea leaves		Kenya & Tanganyika	October, November 1960	49
	Black tea leaves		Kenya & Uganda	May, July 1960	19
	Black tea leaves	Sao Paulo	Brazil	August, October 1960	160
	Black tea leaves	Sao Paulo	Brazil	November, December 1960	200
	Black tea leaves	Misiones	Argentina	Early 1960	37
	Black tea leaves	Misiones	Argentina	Late 1960	47
	Black tea leaves		Java	June, July 1960	36
	Black tea leaves		Java	September 1960	71
	Black tea leaves		Java	January, February 1960	83
	Black tea leaves		Sumatra	May, July 1960	40
	Black tea leaves		Formosa	April-October 1960	450
	Black tea leaves		Formosa	August-October 1961	1120
	Green tea leaves		Japan	May-June 1960	180
	Black tea leaves		S. India	May, July 1960	115
	Black tea leaves				89
	Black tea leaves		S. India	December 1960, January 1961	310
	Black tea leaves		N. India	June 1960	240
	Black tea leaves		N. India	November, December 1960	1163
	Black tea leaves		Ceylon	July, August 1960	315
	Black tea leaves		Ceylon	September, October 1960	110
	Green coffee beans		Mexico	1960	33
	Green coffee beans		Madagascar	1960	31
	Coffee		Uganda	1960	9.5
	Cocoa beans		Samoa	1960	8.2
	Cocoa beans		Ivory Coast	1960	15
	Cocoa beans		Brazil	1960	8.8
Wheat and derivatives	Wheat	Baltimore	Md.	1960	59
	Wheat	Accomack	Va.	1961	53
	Wheat	Johnson	Kans.	July, August 1961	11
	Wheat	Phillips & Sedgwick	Colo.	July 1960	28
	Wheat (t)	Canyon	Idaho	August 1960	3.3
	Bran (t)	Canyon	Idaho	August 1960	9.6
	Flour (t)	Canyon	Idaho	August 1960	0.81
	Wheat (u)	Kimball	Nebr.	July 15, 1960	10
	Bran (u)	Kimball	Nebr.	July 15, 1960	49
	Flour (u)	Kimball	Nebr.	July 15, 1960	3.8
	Bran	Texas	Mo. Wyo. & Mont.	July 1, 1960	29
	Bran			1960	18
	Bran	Onondaga & Oneida	N. Y.	1960	73
	Flour	Cache	Utah	July 15, 1960	0.88
	Flour	Solano	Calif.	September 13, 1960	0.77
	Flour		Mo. & Ill.	July 1, 1960	2.4
	Flour	Yates	N. Y.	August 15, 1960	3.1
Dairy products	Milk, evaporated	Neosho & Wilson	Kans.	December 19, 1960	4.6
	Milk, evaporated	Cache	Utah	December 1960	10
	Milk, evaporated	Grant	Ind.	December 29, 1960	14
	Milk, evaporated	Defiance	Ohio	December 24, 1960	2.1
	Cheese, cheddar	Marion & Clackamas	Oreg.	February 4, 1961	13
	Cheese, cheddar	Marion & Clackamas	Oreg.	January 19, 1961	28
	Cheese, cheddar	Wayne	Utah	October 26, 1960	32
	Cheese, cheddar	Wayne	Utah	August 28, 1960	17
	Cheese, cheddar		N. Y.	December 28, 1960	35
	Cheese, cheddar	Scott, Carver, Sibley, Mcleod	Minn.	September 15, 1960	29

TABLE 1.—STRONTIUM-90 CONTENT OF VARIOUS RAW AND PROCESSED FOODS—Continued

[Concentrations in μμc/kg original material]

Category	Product	Origin		Date harvested or processed	Sr^{90}
		County	State or country		
Seafoods	Oysters	Gulf of Mexico		November 7, 1960	1.2
	Oysters	York River	Va.	January 1961	9.8
	Lobster, Rock		Australia	1960	1.3
	Clams	Core Sound	N. C.	December 1960	77
Baby foods	Spinach, creamed, strained		N. Y.	Spring 1961	5.3
	Green Beans, strained		N. C.	July 10, 1961	25
	Peas, strained		Mich.	July 13, 1960	4.1
	Sweet Potatoes, strained		N. C.	January 9, 1961	6.3
	Carrots, strained		Mich.	September 29, 1960	1.8
	Squash, strained		N. Y.	October 9, 1960	5.4
	Apricots, strained w/tapioca		Calif.	June 20, 1960	1.3
	Plums, strained w/tapioca		Mich.	1960	0.71
	Pears, Junior		Mich.	1960	2.0
	Applesauce, strained		N. C.	November 5, 1960	0.75
	Applesauce, strained		Calif.	September 1960	0.13
	Chicken broth				1.4
	Veal, strained				0.51
	Veal, strained			May 16, 1960	1.2
	Wheat flour				4.2
	Wheat gluten		Ohio		6.1
	Wheat germ		N. Y.		44
	Wheat germ		Minn.		23
	Corn flour		Ind.		0.10
	Corn flour		Ill.		5.2
	Oat flour		Iowa		5.0
	Oat flour		Mo.		5.8
	Oat flour		Iowa		5.7
	Soy flour		Ill.		27
	Rice flour		Calif.		0.90

TABLE 2.—STRONTIUM-90 CONTENT OF POULTRY BONES AND EGGS

[Concentrations in μμc/kg original material]

Category	Product	Origin		Date harvested or processed	Sr^{90}
		County or city	State or county		
Bones (not dried)	Fowl, 6 mo-2 yr		Maine	1961	120
	Turkey, "old"		Md.	1961	130
	Fowl, 6 mo-2 yr		N. Y.	1961	120
	Fowl, 6 mo-2 yr		Va.	1961	190
	Fowl, age?		Tex.	1961	110
	Turkey, 16-20 wks		Utah	1961	130
	Turkey, 16-20 wks		Ind.	1961	43
	Fryer, 8-12 wks		Calif.	1961	11
	Fryer, 8-12 wks		Conn.	1961	41
	Fryer, age?		N. C.	1961	17
	Turkey, 16-20 wks		Calif.	1961	37
	Turkey, 16-20 wks		Calif.	1961	31
Eggs	Eggs	Kalamazoo	Mich.	August 1960	3.0
	Eggs		Calif.	September 1960	1.2
	Egg shell	Buchanan	Mo.	November 1960	100

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SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health, Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *Radiological Health Data (RHD)* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During November 1961, the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since September 15, the sampling schedule has been accelerated.

During the second week in September, when increased levels of gross beta radioactivity in air were reported by the Radiation Surveil-

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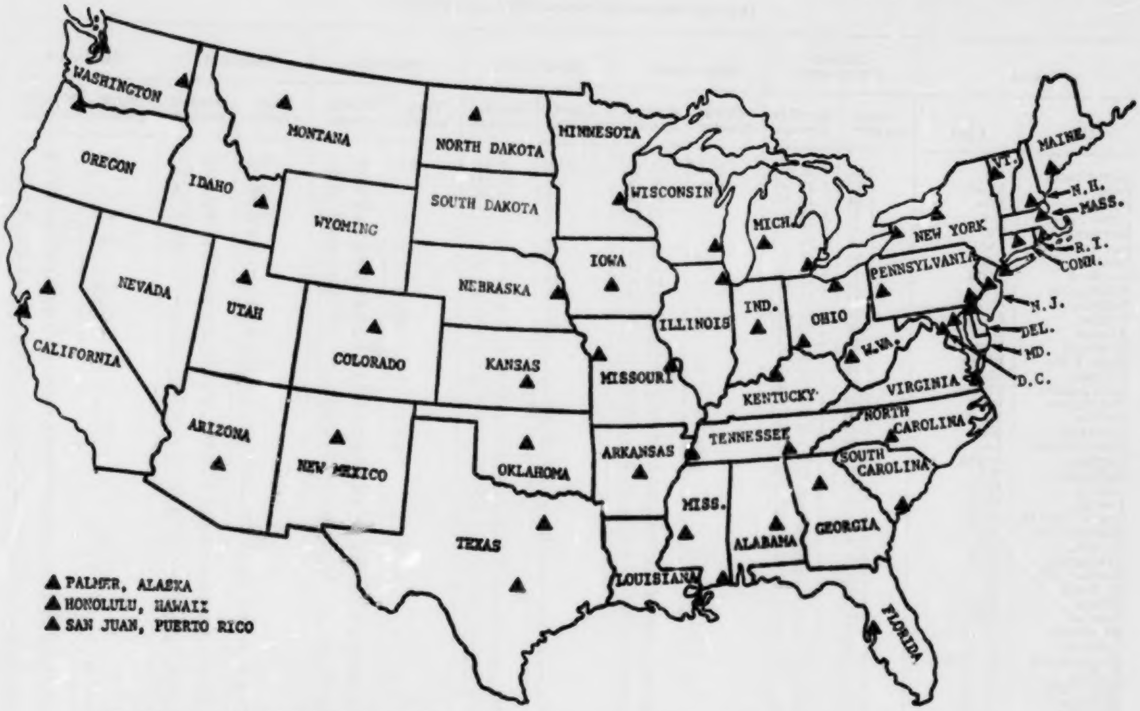
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICH.
IND.
OHIO
KENTUCKY
TENNESSEE
MISS.
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W.VA.
PENNSYLVANIA
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
D.C.
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, NOVEMBER 1961

lance Network, the frequency of milk sampling was accelerated at selected stations. Daily sampling of pasteurized milk, with analyses for iodine-131 content, was initiated on September 19, 1961, at six selected stations.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum levels of detection for strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 in terms of μμc/liter are 5, 1, 10, 5, and 10, respectively.

A comparison was made of cesium-137 concentrations in milk to show that they remained quite constant throughout the month. A number of milk samples collected during November from locations with high (90 μμc/liter), medium (20 μμc/liter), and low (<5 μμc/liter) concentrations were analyzed. The data indicate that cesium-137 levels remain quite constant throughout the month. Therefore, many sampling locations will have only one analysis performed each month for cesium-137.

Table 1 presents a summary of all available analyses. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the average for the month. When a radionuclide was not detectable, one half of the minimum level of detection was used for averaging.

The sampling schedule in effect during the month of November was as follows:

(a) Daily sampling at:

Chicago, Ill.
New Orleans, La.
St. Louis, Mo.
New York, N. Y.
Austin, Tex.
Seattle, Wash.

(b) Three samples per week at:

Palmer, Alaska
Sacramento, Calif.
Denver, Colo.
Washington, D. C.
Tampa, Fla.
Atlanta, Ga.
Wichita, Kans.
Jackson, Miss.
Pascagoula, Miss.
Omaha, Nebr.
Charleston, S. C.
Salt Lake City, Utah
Milwaukee, Wis.

(c) Two samples per week at remainder of the stations.

TABLE 1.—RADIOACTIVITY IN MILK—PASTEURIZED MILK AREA SAMPLING STATIONS, NOVEMBER 1961

[Average radioactivity concentrations in μμc/liter]

Area		Calcium (grams/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average	Third quarter	Monthly average
Montgomery	Ala.	[a] NA	[b]1.27 (1)	NA	<5 (1)	NA	6 (1)	NA	30 (1)	NA	<5 (1)	NA	30 (1)
Palmer	Alaska	1.12	1.14 (4)	[c] —	50 (4)	7	10 (4)	—	40 (12)	10	15 (10)	—	10 (10)
Phoenix	Ariz.	1.04	1.10 (2)	—	10 (2)	4	12 (2)	—	80 (9)	<5	5 (8)	—	10 (8)
Little Rock	Ark.	1.21	1.22 (4)	—	85 (4)	16	13 (4)	—	150 (7)	10	15 (1)	—	30 (4)
Sacramento	Calif.	1.10	1.16 (7)	<5	15 (7)	5	4 (7)	<10	30 (21)	10	10 (10)	<10	<10 (13)
San Francisco	Calif.	1.06	1.04 (1)	—	5 (1)	4	2 (1)	—	30 (8)	10	5 (6)	—	<10 (6)
Denver	Colo.	1.05	1.15 (4)	<5	25 (4)	5	5 (4)	20	40 (8)	10	10 (6)	<10	<10 (8)
Hartford	Conn.	1.15	1.16 (4)	—	40 (4)	8	8 (4)	—	30 (8)	15	10 (1)	—	30 (4)
Wilmington	Del.	1.18	1.14 (4)	—	85 (4)	10	8 (4)	—	60 (8)	15	15 (1)	—	40 (4)
Washington	D. C.	1.14	1.18 (4)	5	50 (4)	7	10 (4)	20	30 (14)	10	10 (1)	<10	20 (4)
Tampa	Fla.	1.24	1.22 (4)	<5	30 (4)	5	6 (4)	20	40 (11)	65	90 (1)	<10	10 (4)
Atlanta	Ga.	1.23	1.20 (4)	<5	15 (4)	10	10 (4)	20	40 (12)	15	10 (1)	<10	10 (4)
Honolulu	Hawaii	1.06	1.11 (1)	—	10 (1)	6	2 (1)	—	20 (7)	10	10 (5)	—	<10 (5)
Idaho Falls	Idaho	1.06	1.01 (1)	—	35 (1)	6	4 (1)	—	100 (7)	5	10 (5)	—	10 (5)
Chicago	Ill.	1.14	1.18 (4)	10	90 (4)	5	6 (4)	40	70 (21)	15	15 (1)	<10	40 (4)
Indianapolis	Ind.	1.16	1.21 (4)	—	65 (4)	6	9 (4)	—	60 (6)	10	<5 (1)	—	40 (4)
Des Moines	Iowa	1.04	1.08 (1)	—	80 (1)	7	11 (1)	—	210 (8)	10	10 (8)	—	20 (8)
Wichita	Kans.	1.08	1.10 (5)	—	45 (5)	11	8 (5)	—	140 (16)	5	10 (7)	—	10 (7)
Louisville	Ky.	1.15	1.19 (4)	—	70 (4)	9	9 (4)	—	80 (8)	5	5 (1)	—	40 (4)
New Orleans	La.	1.28	1.24 (4)	5	55 (4)	15	14 (4)	20	60 (15)	25	20 (1)	<10	40 (4)
Portland	Maine	1.19	1.21 (4)	10	60 (4)	9	12 (4)	10	30 (8)	20	25 (1)	<10	40 (4)
Baltimore	Md.	1.16	1.16 (4)	—	40 (4)	10	7 (4)	—	30 (9)	15	<5 (1)	—	30 (4)
Boston	Mass.	1.17	1.18 (4)	—	90 (4)	10	10 (4)	—	40 (8)	20	<5 (1)	—	40 (4)
Detroit	Mich.	1.14	1.18 (4)	—	65 (4)	6	7 (4)	—	90 (6)	5	15 (1)	—	30 (4)
Grand Rapids	Mich.	1.18	1.17 (4)	—	90 (4)	7	6 (4)	—	60 (7)	5	<5 (1)	—	40 (4)
Minneapolis	Minn.	1.07	1.11 (1)	—	140 (1)	9	10 (1)	—	150 (9)	15	15 (7)	—	10 (7)
Jackson	Miss.	1.26	1.26 (4)	5	70 (4)	12	14 (4)	50	60 (12)	15	5 (1)	<10	40 (4)
Pascagoula	Miss.	NA	1.26 (4)	NA	70 (4)	NA	15 (4)	70	80 (7)	NA	20 (1)	NA	30 (4)
Kansas City	Mo.	1.04	1.04 (1)	—	75 (1)	9	11 (1)	—	190 (7)	5	15 (3)	—	20 (3)
St. Louis	Mo.	1.07	1.16 (5)	10	50 (5)	8	10 (5)	90	100 (26)	10	10 (10)	<10	10 (10)
Helena	Mont.	1.05	1.06 (1)	—	25 (1)	7	4 (1)	—	110 (10)	15	20 (8)	—	10 (8)
Omaha	Nebr.	1.13	1.16 (5)	—	100 (5)	8	9 (5)	—	120 (15)	10	10 (9)	—	10 (9)
Manchester	N. H.	1.19	1.18 (4)	—	65 (4)	9	11 (4)	—	40 (8)	40	30 (1)	—	40 (4)
Trenton	N. J.	1.14	1.17 (4)	—	45 (4)	8	10 (4)	—	20 (6)	10	5 (1)	—	20 (4)
Albuquerque	N. Mex.	1.09	1.16 (1)	—	5 (1)	3	3 (1)	—	60 (9)	5	10 (8)	—	10 (8)
Buffalo	N. Y.	1.13	1.12 (4)	—	60 (4)	7	6 (4)	—	20 (6)	10	<5 (1)	—	30 (4)
New York	N. Y.	1.13	1.13 (4)	5	60 (4)	9	8 (4)	50	40 (22)	15	15 (1)	10	40 (4)
Syracuse	N. Y.	1.15	1.18 (4)	—	55 (4)	6	8 (4)	—	20 (8)	10	15 (1)	—	20 (4)
Charlotte	N. C.	1.22	1.25 (4)	—	20 (4)	12	11 (4)	—	20 (8)	10	<5 (1)	—	20 (4)
Minot	N. D.	1.04	1.14 (1)	5	5 (1)	7	9 (1)	20	20 (6)	10	10 (4)	<10	10 (4)
Cincinnati	Ohio	1.20	1.22 (4)	—	60 (4)	9	9 (4)	—	90 (5)	<5	<5 (1)	—	4 (4)
Cleveland	Ohio	1.17	1.18 (4)	—	85 (4)	7	7 (4)	—	80 (7)	5	10 (1)	—	30 (4)
Oklahoma City	Okla.	1.19	1.21 (4)	—	80 (4)	6	6 (4)	—	160 (9)	5	<5 (1)	—	30 (4)
Portland	Oreg.	1.10	1.02 (1)	—	180 (1)	11	23 (1)	—	170 (7)	20	30 (5)	—	40 (5)
Philadelphia	Pa.	1.18	1.18 (4)	—	50 (4)	8	8 (4)	—	40 (8)	15	5 (1)	—	30 (4)
Pittsburgh	Pa.	1.15	1.15 (4)	—	50 (4)	11	10 (4)	—	30 (8)	10	10 (1)	—	30 (4)
San Juan	P. R.	1.17	1.14 (4)	—	25 (4)	4	5 (4)	—	20 (8)	10	<5 (1)	—	20 (4)
Providence	R. I.	1.15	1.18 (4)	—	90 (4)	12	8 (4)	—	50 (8)	20	10 (1)	—	40 (4)
Charleston	S. C.	1.22	1.10 (4)	<5	15 (4)	11	11 (4)	30	20 (11)	30	30 (1)	<10	30 (4)
Chattanooga	Tenn.	1.26	1.27 (4)	—	45 (4)	12	9 (4)	—	40 (8)	15	<5 (1)	—	30 (4)
Memphis	Tenn.	1.23	1.23 (4)	—	65 (4)	12	14 (4)	—	80 (9)	5	10 (1)	—	30 (4)
Austin	Tex.	1.20	1.17 (4)	<5	30 (4)	2	4 (4)	10	60 (27)	<5	<5 (1)	<10	30 (4)
Dallas	Tex.	1.17	1.23 (4)	<5	55 (4)	6	10 (4)	10	100 (7)	10	<5 (1)	<10	30 (4)
Salt Lake City	Utah	1.16	1.22 (4)	5	20 (4)	4	4 (4)	50	60 (12)	10	10 (9)	<10	10 (9)
Burlington	Vt.	1.14	1.17 (4)	—	60 (4)	8	11 (4)	—	50 (8)	15	<5 (1)	—	30 (4)
Norfolk	Va.	1.22	1.22 (4)	—	50 (4)	9	11 (4)	—	30 (8)	10	15 (1)	—	30 (4)
Seattle	Wash.	1.06	1.16 (6)	10	90 (6)	11	16 (6)	<10	120 (25)	15	15 (8)	<10	10 (9)
Spokane	Wash.	1.04	NA	—	NA	9	NA	—	60 (9)	20	15 (5)	—	10 (5)
Charleston	W. Va.	1.17	1.17 (4)	—	70 (4)	11	10 (4)	—	20 (8)	10	<5 (1)	—	20 (4)
Milwaukee	Wis.	1.17	1.19 (4)	—	65 (4)	5	7 (4)	—	80 (17)	10	15 (1)	—	30 (4)
Laramie	Wyo.	1.04	1.13 (1)	—	<5 (1)	7	4 (1)	—	30 (8)	15	15 (6)	—	<10 (6)
Network average		1.14	1.16	5	54	8	9	30	65	15	12	<10	20

[a] NA indicates no analysis made. Montgomery, Ala., and Pascagoula, Miss., stations were not operating during third quarter.

[b] Numbers in parentheses indicate total number of analyses reported during the month.

[c] Dash indicates that the average concentration during the third quarter was reported to be less than the minimum level of detection. The minimum levels of detection for Sr^{89}, Sr^{90}, I^{131}, Cs^{137}, and Ba^{140} in terms of μμc liter are 5, 1, 10, 5, and 10, respectively. (Dashes are not used in calculation of network averages.)

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Comparison of the results of the November averages with the third quarter averages shows that the November stable calcium, strontium-90, and cesium-137 results are generally within anticipated variations. The analyses for strontium-89 show that the concentrations of this nuclide during November generally showed an increase over the October data. The November iodine-131 and barium-140 levels show a decrease from the previous month.

[Editor's note: Rapid City, South Dakota becomes a reporting station this month; however, it will not be indicated on the figure showing sampling stations until analytical results are available.]

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SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provisions of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies, and industrial organizations, commenced operations in October 1957. During October 1961, 94 sampling stations submitted water samples for analyses. These stations are located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 360 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the U.S.S.R. has resulted in an increase in radioactivity of surface waters. Evidence obtained during October–December 1961 indicates a 5 to 10-fold increase in gross beta radioactivity of the surface waters over the 1960 average in some areas, particularly in North Central, Northeastern, and Eastern United States. The

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	October 1961					
	Total Sr^{90}	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa.	0.2	4	16	20	0	<1	<1
Animas River: Cedar Hill, N. Mex.	0.3	11	30	41	1	4	5
Apalachicola River: Chattahoochee, Fla.	0.4	2	3	5	ᵃ—	—	—
Arkansas River:							
Coolidge, Kansas	2.3	91	79	170	6	46	52
Ponca City, Okla.	—	38	58	96	2	10	12
Pendleton Ferry, Ark.	—	46	17	63	7	1	8
Big Sioux River: Sioux Falls, S. Dak.	0.4	29	75	104	1	3	4
Chattahoochee River:							
Atlanta, Ga.	—	4	3	7	0	0	0
Columbus, Ga.	—	3	5	8	0	0	0
Clear Water River: East Lewiston, Idaho	—	10	22	32	0	0	0
Colorado River:							
Loma, Colo.	—	24	46	70	1	4	5
Page, Ariz.	—	395	39	434	75	7	82
Boulder City, Nev.	1.0	7	28	35	0	6	6
Parker Dam, Calif.	—	3	23	26	0	4	4
Yuma, Ariz.	—	3	50	53	—	—	—
Columbia River:							
Wenatchee, Wash.	—	2	4	6	0	1	1
Pasco, Wash.	1.1	79	623	702	0	0	0
Bonneville Dam, Oreg.	ᵇ0.6	15	305	320	0	1	1
Clatskanie, Oreg.	—	16	168	184	—	—	—
McNary Dam, Oreg.	1.2	114	168	282	0	1	1
Connecticut River: Northfield, Mass.	0.4	5	8	13	0	0	0
Cumberland River: Clarksville, Tenn.	0.4	1	5	6	0	0	0
Delaware River:							
Martins Creek, Pa.	—	4	4	8	0	0	0
Philadelphia, Pa.	—	7	14	21	0	0	0
Escambia River: Century, Fla.	ᵇ0.9	6	8	14	—	—	—
Great Lakes:							
Buffalo, N. Y.	—	3	7	10	0	0	0
Detroit, Mich.	ᵇ0.8	4	11	15	0	0	0
Port Huron, Mich.	0.4	2	0	[illegible]	0	2	2
Milwaukee, Wis.	—	5	7	12	0	1	1
Sault Ste. Marie, Mich.	—	1	4	5	—	—	—
Gary, Ind.	0.2	1	7	8	0	1	1
Duluth, Minn.	—	3	3	6	—	—	—
Hudson River: Poughkeepsie, N. Y.	0.2	2	6	8	0	0	0
Illinois River:							
Peoria, Ill.	0.4	5	22	27	—	—	—
Grafton, Ill.	—	0	17	17	0	2	2
Kanawha River: Winfield Dam, W. Va.	—	6	7	13	—	—	—
Klamath River: Copco, Oreg.	—	4	7	11	0	<1	<1
Little Miami River: Cincinnati, Ohio	1.1	6	16	22	<1	1	1
Merrimack River: Lowell, Mass.	ᵇ0.7	6	17	23	—	—	—
Mississippi River: St. Paul, Minn.	0.9	4	29	33	0	0	0
Mississippi River:							
Dubuque, Iowa	—	15	23	38	—	—	—
Burlington, Iowa	0.6	3	20	23	1	1	2
E. St. Louis, Ill.	—	12	19	31	<1	1	1
Cape Girardeau, Mo.	0.8	52	20	72	7	1	8
West Memphis, Ark.	—	21	14	35	0	0	0
Delta, La.	ᵇ0.4	23	18	41	—	—	—
New Orleans, La.	—	13	15	28	0	1	1
Vicksburg, Miss.	—	34	17	51	4	1	5
Missouri River:							
Williston, N. Dak.	—	34	12	46	9	4	13
Bismarck, N. Dak.	—	12	13	25	1	0	1
Yankton, S. Dak.	0.6	9	30	39	1	3	4
Omaha, Nebr.	—	20	27	47	2	3	5
St. Joseph, Mo.	—	34	29	63	3	4	7
Kansas City, Kan.	—	34	20	54	5	2	7
St. Louis, Mo.	1.4	28	18	46	—	—	—
Monongahela River: Pittsburgh, Pa.	0.4	6	16	22	0	<1	<1
North Platte River: Henry, Nebr.	—	12	45	57	0	24	24
Ohio River:							
East Liverpool, Ohio	0.4	2	31	33	—	—	—
Huntington, W. Va.	—	7	12	19	0	0	0
Cincinnati, Ohio	—	10	3	13	0	0	0
Louisville, Ky.	0.4	4	13	17	<1	<1	1
Evansville, Ind.	—	13	19	32	0	<1	<1
Cairo, Ill.	1.1	—	—	—	—	—	—
Ouachita River: Bastrop, La.	—	11	12	23	1	1	2
Potomac River:							
Williamsport, Md.	—	3	15	18	0	0	0
Great Falls, Md.	—	5	14	19	0	1	1
Platte River: Plattsmouth, Nebr.	—	40	42	82	7	3	10
Red River, North: Grand Forks, N. Dak.	—	21	39	60	0	3	3
Red River, South:							
Index, Ark.	—	23	21	44	7	1	8
Denison, Tex.	—	2	34	36	0	0	0
Alexandria, La.	1.0	14	13	27	5	2	7
Rio Grande River:							
Alamosa, Colo.	ᵇ0.4	3	15	18	0	2	2
El Paso, Tex.	—	0	0	0	—	—	—
Laredo, Tex.	—	18	13	31	3	3	6
Brownsville, Tex.	—	9	19	28	—	—	—

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	October 1961					
	Total Sr-90 [b]	Beta activity			Alpha activity		
		Suspended	Dissolved	Total	Suspended	Dissolved	Total
Roanoke River: John H. Kerr Reservoir & Dam, Va.	—	3	6	9	0	0	0
Sabine River: Ruliff, Tex.	—	4	5	9	—	—	—
San Juan River: Shiprock, N. Mex.	—	44	42	86	6	8	14
St. Lawrence River: Massena, N. Y.	—	4	7	11	—	—	—
Schuylkill River: Philadelphia, Pa.	—	0	16	16	—	—	—
Savannah River:							
Port Wentworth, Ga.	0.4	6	56	62	0	0	0
North Augusta, S. C.	—	2	6	8	0	0	0
Shenandoah River: Berryville, Va.	—	2	14	16	<1	1	1
Snake River: Wawawai, Wash.	0.3	4	18	22	0	1	1
South Platte River: Julesburg, Colo.	0.7	27	63	90	4	30	34
Susquehanna River:							
Sayre, Pa.	0.3	6	11	17	0	0	0
Conowingo, Md.	0.7	5	5	10	0	0	0
Tennessee River:							
Pickwick Landing, Tenn.	—	0	33	33	1	0	1
Chattanooga, Tenn.	0.6	2	14	16	—	—	—
Bridgeport, Ala.	0.7	3	17	20	0	0	0
Tombigbee River: Columbus, Miss.	—	3	6	9	0	0	0
Truckee River: Farad, Calif.	—	9	17	26	0	0	0
Yakima River: Richland, Wash.	0.4	6	18	24	0	1	1
Yellowstone River: Sidney, Mont.	—	43	16	59	—	—	—

[a] Dash denotes no sample received or no determinations made.
[b] April–September strontium-90 data.

greater percentage of increase in the radioactivity is in the suspended solids.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determination varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers, determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Beginning September 1, 1961, gross beta determinations are to be made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Beginning October 1, 1961, gross alpha determinations are to be made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all data reported for the period indicated. The reported strontium-90 data are the results of determinations on three-month composite samples for the quarter ending in the month shown.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Water Works Association, 51*, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *Journal of the American Water Works Association, 52*, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association, 53*, 704 (1961).

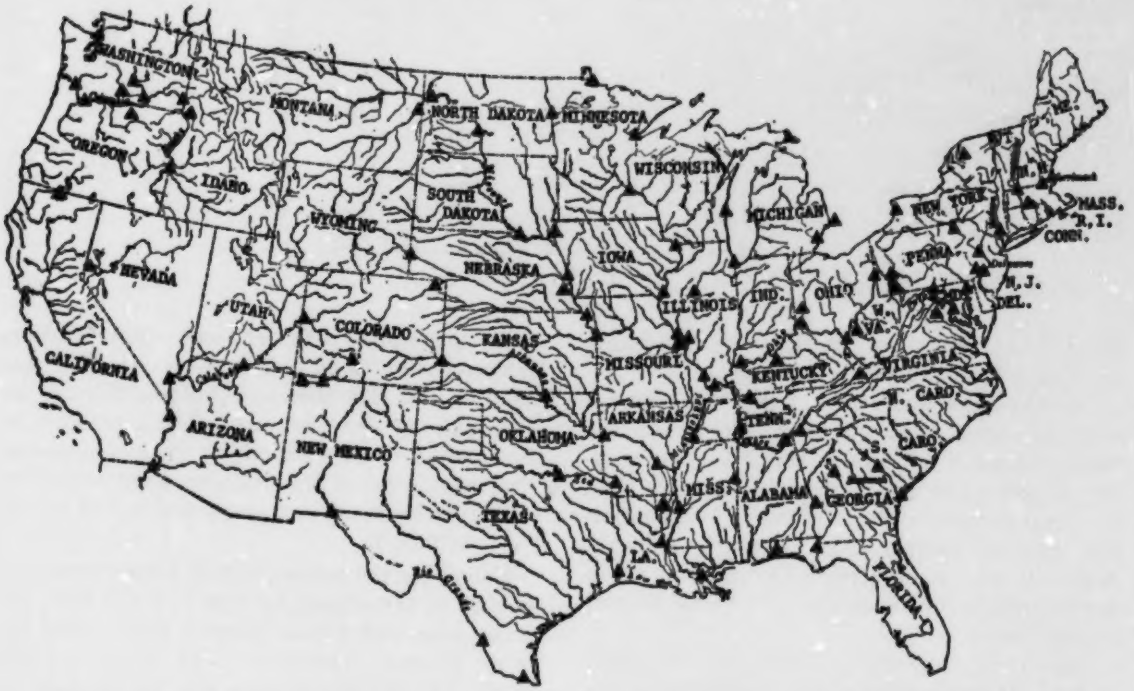
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
IDAHO
WISCONSIN
SOUTH DAKOTA
WYOMING
MICHIGAN
NEW YORK
ME.
VT.
N.H.
MASS.
R.I.
CONN.
NEVADA
NEBRASKA
IOWA
PENNA.
N.J.
DEL.
UTAH
COLORADO
ILLINOIS
IND.
OHIO
W. VA.
KANSAS
MISSOURI
KENTUCKY
VIRGINIA
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
TENN.
N. CARO.
S. CARO.
TEXAS
MISS.
ALABAMA
GEORGIA
LA.
FLORIDA

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, OCTOBER 1961

Monitoring of Water Supplies Around the Nevada Test Site

U.S. Atomic Energy Commission

By contract with the Atomic Energy Commission the Public Health Service has conducted an off-site monitoring program around the Nevada Test Site (NTS) since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23rd Semiannual Reports to Congress and by the Public Health Service in the 1957 Congressional Hear-

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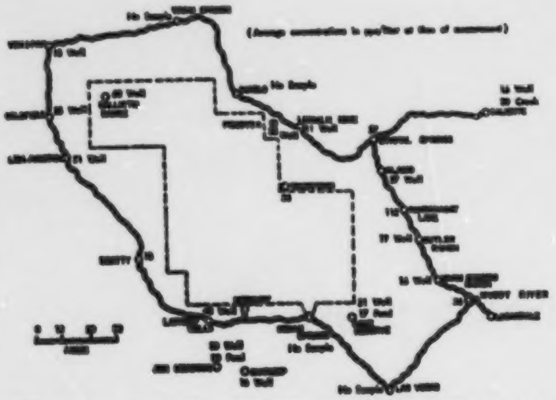

FIGURE 1.—GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR NOVEMBER 1961

ings, "The Nature of Radioactive Fallout and Its Effects on Man."

Figure 1 summarizes gross beta measurements in water supplies located in the NTS off-site area for November 1961.

The lower limit of detectability with the equipment used is about 10 micromicrocuries per liter.

TABLE 1.—DESCRIPTION OF WATER SAMPLING POINTS, NEVADA TEST SITE

Location	Source	Population served
Las Vegas	13 wells—680 to 1,250'' depth plus Lake Mead supply	40,000.
Game Reserve	400' drilled well	20.
Indian Springs	600' drilled well	Average 250.
Pahrump	75' driven well	10–50.
Ash Meadows	Spring 25' deep	8.
Lathrop Wells	3 wells—600' deep	Average 15.
Beatty	Spring	550.
Lida Junction	125' drilled well	2–10.
Goldfield	Spring	Average 200.
Tonapah	2 drilled wells—60' depth	Average 1,500.
Warm Springs	Multiple springs—no improvement	10.
Diablo	Well	State Highway Station.
Lincoln Mine	2 driven wells	3.
Caliente	Springs	Average 10–12.
Crystal Springs	Free flowing spring	0.
Alamo	2 wells—50–67' deep	Average 175.
Pahranagat Lake	Surface	Not used for domestic purposes.
Butler Ranch	Flowing spring	1.
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool.
Logandale	Drilled well	300.
Ballistic Range	Drilled well	10–15.

SECTION V. — OTHER DATA

External Gamma Activity

Division of Radiological Health, Public Health Service

Portable survey instruments are available at stations of the Radiation Surveillance Network for recording levels of external gamma radiation. Measurements are made daily approximately three feet above the ground. These readings are not precise, but are sufficiently accurate to illustrate any significant variations above background. The differences among the values shown in the following table are within the variance anticipated due to differences in normal background and instrument response characteristics.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, JANUARY 1962

Station location		Average (mr hr)	Station location		Average (mr hr)
City	State		City	State	
Adak	Alaska	0.01	Lansing	Mich.	0.02
Anchorage	Alaska	0.01	Minneapolis	Minn.	0.01
Attu	Alaska	0.01	Jackson	Miss.	0.01
Cold Bay	Alaska	0.01	Pascagoula	Miss.	—
Fairbanks	Alaska	0.01	Jefferson City	Mo.	0.01
Juneau	Alaska	0.02	Helena	Mont.	0.03
Kodiak	Alaska	0.01	Lincoln	Nebr.	0.01
Nome	Alaska	0.01	Trenton	N. J.	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex.	—
St. Paul Island	Alaska	[a] —	Albany	N. Y.	0.02
Phoenix	Ariz.	0.02	New York	N. Y.	—
Little Rock	Ark.	0.01	Gastonia	N. C.	0.02
Berkeley	Calif.	0.01	Bismarck	N. Dak.	0.01
Los Angeles	Calif.	—	Columbus	Ohio	0.01
Denver	Colo.	0.02	Oklahoma City	Okla.	0.02
Hartford	Conn.	0.01	Ponca City	Okla.	0.04
Washington	D. C.	0.02	Portland	Oreg.	0.02
Jacksonville	Fla.	0.01	Harrisburg	Pa.	0.01
Miami	Fla.	0.01	San Juan	P. R.	—
Atlanta	Ga.	0.03	Providence	R. I.	0.02
Agana	Guam	0.02	Columbia	S. C.	0.02
Honolulu	Hawaii	0.02	Pierre	S. Dak.	0.02
Boise	Idaho	0.02	Nashville	Tenn.	0.01
Springfield	Ill.	0.01	Austin	Tex.	0.01
Indianapolis	Ind.	0.01	El Paso	Tex.	0.02
Iowa City	Iowa	0.03	Salt Lake City	Utah	0.02
Topeka	Kans.	0.02	Richmond	Va.	0.01
Frankfort	Ky.	0.01	Seattle	Wash.	0.01
New Orleans	La.	0.02	Madison	Wis.	0.02
Augusta	Maine	0.02	Cheyenne	Wyo.	0.02
Baltimore	Md.	0.02	Sundance	Wyo.	—
Lawrence	Mass.	0.02			

[a] Dash indicates no data received.

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Byproduct Material Licensees

Division of Licensing and Regulation, U.S. Atomic Energy Commission

The Atomic Energy Commission periodically makes available tabulations of their byproduct material licensees giving the locations and types of licensees. The tabulation, as of December 1961, is presented in table 1. "Byproduct material" is defined as any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation incidental to the processes of producing or utilizing special nuclear materials.

TABLE 1.—LOCATION AND TYPE OF BYPRODUCT MATERIALS LICENSEES, DECEMBER 1961

State or territory	Medical Institutions and Physicians			Colleges and Univ.	Industrial Firms		Federal and State Laboratories		Foundations and Institutes	Other	Sum of totals
	Private practice	Other	Total		Industrial radiography	Total	Civil defense	Total			
Alaska	1	1	2	1	0	0	5	10	0	0	13
Alabama	22	17	39	4	8	19	9	16	1	0	79
Arizona	14	8	22	3	1	8	16	18	0	1	52
Arkansas	13	8	21	1	0	9	3	2	0	0	33
California	213	119	332	18	47	246	21	65	3	9	673
Colorado	10	22	32	7	5	30	25	31	1	3	104
Connecticut	18	19	37	6	13	49	11	16	1	1	110
Delaware	1	3	4	1	2	12	6	6	0	0	23
Dist. of Col	12	16	28	4	3	7	17	33	2	2	76
Florida	54	30	84	5	8	22	28	32	0	1	144
Georgia	21	23	44	5	6	11	16	20	0	0	80
Hawaii	12	4	16	1	2	8	2	5	1	0	31
Idaho	3	3	6	2	3	3	1	2	0	0	13
Illinois	42	91	133	7	16	129	26	44	5	3	321
Indiana	29	29	58	9	14	47	18	18	0	3	135
Iowa	26	23	49	12	4	12	24	25	0	1	99
Kansas	10	16	26	3	6	18	19	20	0	0	67
Kentucky	18	14	32	4	3	14	19	23	0	0	73
Louisiana	17	22	39	6	14	32	9	11	2	1	91
Maine	6	11	17	2	2	7	3	4	0	1	31
Maryland	17	21	38	7	7	24	10	32	2	1	104
Massachusetts	17	64	81	20	15	100	19	34	6	3	243
Michigan	47	59	106	11	16	56	48	52	2	2	229
Minnesota	20	26	46	14	6	23	110	111	0	0	194
Mississippi	7	7	14	3	4	9	9	10	0	0	36
Missouri	39	44	83	6	8	32	30	31	0	1	153
Montana	4	9	13	3	0	3	1	2	0	0	21
Nebraska	10	11	21	3	1	4	27	27	0	1	56
Nevada	4	3	7	1	1	5	4	5	0	0	18
New Hampshire	2	10	12	4	2	7	9	11	0	0	34
New Jersey	60	49	109	3	23	140	25	31	2	2	287
New Mexico	10	8	18	6	1	16	3	8	0	0	48
New York	177	171	348	38	31	215	60	67	12	10	690
North Carolina	30	23	53	7	0	17	45	49	0	1	127
North Dakota	5	3	8	2	1	2	8	9	0	0	21
Ohio	75	75	150	14	36	124	40	60	3	2	353
Oklahoma	30	14	44	5	10	32	13	15	1	0	97
Oregon	20	12	32	7	7	11	33	36	1	0	87
Panama	0	1	1	0	0	0	0	0	0	0	1
Pennsylvania	47	95	142	20	56	174	108	121	6	4	467
Puerto Rico	4	5	9	3	1	3	2	2	0	0	17
Rhode Island	2	6	8	4	1	8	5	6	0	0	26
South Carolina	12	7	19	3	3	6	11	14	0	0	42
South Dakota	9	8	17	4	0	2	11	11	0	0	34
Tennessee	20	22	42	5	4	20	11	13	0	1	81
Texas	114	58	172	20	36	122	26	44	4	2	364
Utah	1	8	9	4	3	16	11	15	0	0	44
Vermont	7	4	11	2	0	3	1	1	0	0	17
Virginia	13	24	37	7	7	37	11	21	0	1	103
Washington	25	18	43	9	9	22	33	38	1	0	113
West Virginia	14	11	25	2	2	18	38	41	0	0	86
Wisconsin	25	39	64	6	17	37	4	6	3	1	117
Wyoming	1	3	4	1	1	7	13	16	0	2	30
Total	1420	1367	2807	343	469	1997	1072	1829	59	60	6595

Cesium-137 Levels in Humans

Walter Reed Army Institute of Research, Washington, D.C., and
U.S. Army Medical Research Unit, Landstuhl, Germany

The whole body counting facilities at the Walter Reed Army Institute of Research (WRAIR), Washington, D. C., and the Medical Research Unit, Landstuhl, Germany, have continued their program for measuring the levels of cesium-137 in people. A description of each facility and previous data were summarized in *Radiological Health Data*, Vol. II, Nos. 4, 7, and 10; subsequent data appeared in Vol. III, No. 1.

This report presents results from Germany for the period September through November 1961, and from Walter Reed for the fourth quarter of 1961. The Landstuhl data are listed by month in table 1 and the Walter Reed data are listed by geographic area in tables 2 and 3.

TABLE 1.—ASSAYS PERFORMED AT THE UNITED STATES ARMY MEDICAL RESEARCH UNIT, LANDSTUHL, GERMANY

Date	Subjects residing in	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
September 1961	West Germany	595	33
October 1961	West Germany	452	34
November 1961	West Germany	587	28

TABLE 2.—ASSAYS PERFORMED AT THE WALTER REED ARMY INSTITUTE OF RESEARCH, FOURTH QUARTER 1961

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Canada	2	21
Central America	1	24
Europe	14	36
Far East	9	19
United States	80	24

TABLE 3.—ASSAYS OF INDIVIDUALS RESIDING WITHIN THE UNITED STATES PERFORMED AT WRAIR, FOURTH QUARTER 1961

State	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)
Alaska	2	43
Arizona	1	17
California	7	17
Colorado	1	20
Connecticut	1	31
Delaware	1	24
District of Columbia	4	26
Florida	1	35
Georgia	2	23
Idaho	1	18
Indiana	1	1
Iowa	1	25
Maryland	8	10
Massachusetts	1	52
Michigan	3	14
Minnesota	1	32
Mississippi	2	32
Missouri	1	12
New Hampshire	1	48
New Jersey	1	4
New Mexico	1	25
New York	7	26
North Dakota	3	30
Oklahoma	1	15
Pennsylvania	10	33
South Dakota	2	31
Texas	5	17
Virginia	8	23
Washington	1	19

TABLE 4.—SUMMARY OF TABLES 1 AND 2—FOURTH QUARTER, 1961

Geographic area	Number of subjects	$\mu\mu c$ Cs^{137}/gm K (average)	Percent MPC[a]
Canada	2	26	0.13
Central America	1	24	0.12
Europe	14	36	0.18
Far East	9	19	0.10
United States	80	24	0.12
West Germany	1634	32	0.16

[a] *Radiological Health Data*, Volume II, Number 4, pages 193 and 194.
[b] Values represent determinations for September through November 1961.

Survey of Radioactivity in Animal Feeds

Food and Drug Administration

A part of the continuing surveillance of radioactivity in foods by the Food and Drug Administration is concerned with the levels of strontium-90 in animal feeds. Table 1 presents the results of analyses of feeds collected during 1960 by representatives of the Food and Drug Administration Districts. This data indicates that hays and alfalfas continue to show relatively high strontium-90 content. Previous data for 1958, 1959, and 1960 have been presented in the May and December 1960 and the September and December 1961 *Radiological Health Data.*

TABLE 1.—STRONTIUM-90 CONTENT OF ANIMAL FEEDS

[Concentrations in μμc/kg original material]

Product	Origin		Harvest date	Strontium-90
	County	State		
Lespedeza hay	Barry	Missouri	1960	900
Lespedeza hay	Ross	Ohio	September 1960	280
Lespedeza hay	Cherokee	Kansas	July, September 1960	45
Alfalfa	Howard	Indiana	June 1, 1960	204
Alfalfa	Cherokee	Indiana	September 1, 1960	370
Dried beet pulp	Saginaw	Michigan	September, October 1960	32
Dried beet pulp	Monterey	California	October 10, 1960	36
Cotton seed meal	Wake	North Carolina	1959	4.6
Sorghum forage	Labett	Kansas	1960	34

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of the respective installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Bettis Atomic Power Laboratory and Shippingport Atomic Power Plant, for the first and second quarters of 1961.

The measured concentration of a radioactive substance in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards Handbook 69.

For the purpose of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, Handbook 69 should be consulted.

The establishment of MPC's does not imply that each nuclide may be permitted to be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low, a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratory.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line No.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{223}, Ra^{224}, Ra^{226}, Pa^{231}, and Th-nat are not present[1]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[1]	600	—
3	If Ra^{226}, Ra^{228} are not present[1]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present[1]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[1]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[1]	—	100
8	Hydrogen-3 (tritium)	3,000,000	200,000
9	Strontium-90	100	10
10	Xenon-133	—	300,000

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent FRC recommendations a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

Bettis Atomic Power Laboratory

Westinghouse Electric Corporation, Pittsburgh, Pennsylvania
First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	November 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	October 1961

The Bettis Atomic Power Laboratory (BAPL), operated for the Atomic Energy Commission by Westinghouse Electric Corporation, was established in 1949. Since that time BAPL has been engaged in research and development work related to naval atomic propulsion systems and the central station atomic power reactor at Shippingport, Pennsylvania.

Liquid Radioactive Waste Disposal

The liquid effluent from the Laboratory is sampled continually and a composite sample is collected and analyzed weekly. This effluent includes the discharge from the Laboratory storm drainage system so that it may include some activity from fallout. The average concentrations of gross radioactivity and strontium-90 are presented in table 2.

Beta-Gamma Background Levels

Beta-gamma background levels are continuously monitored and recorded at a monitoring station located inside the western boundary of the laboratory property as shown in figure 1.

TABLE 2.—RADIOACTIVITY IN LIQUID WASTES

[Average concentrations in $\mu\mu c$/liter]

Type of activity	First quarter 1961	Second quarter 1961
Gross activity[1]	550	490
Strontium-90[2]	<1	<1

[1] For the environmental MPC used here for gross activity see line 1 in table 1.

[2] The Sr^{90} concentration for the fourth quarter 1960, reported in the October 1961 *Radiological Health Data* should be changed from 14 to 0.9 $\mu\mu c$/liter.

The first and second quarter averages, 0.015 and 0.018 millirads per hour respectively, may be compared with the 0.01 to 0.04 mr/hr range measured throughout the United States by the

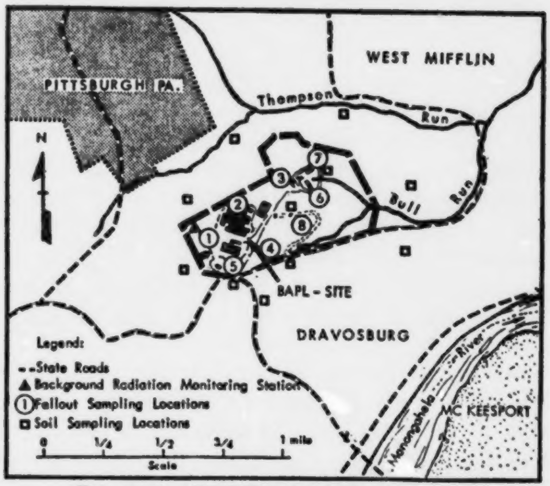

FIGURE 1.—BETTIS ATOMIC POWER LABORATORY SAMPLING STATIONS

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TABLE 3.—AVERAGE BETA ACTIVITY IN FALLOUT

[Average deposition rates in mc/km²/mo]

Station number (See figure 1)	First quarter 1961	Second quarter 1961
Upwind:		
1	1.5	3.5
5	2.0	3.5
Downwind:		
2	2.0	4.2
3	2.0	4.6
4	1.5	5.0
6	2.0	4.2
7	2.0	4.2
8	1.5	3.9

Radiation Surveillance Network, Public Health Service during March 1961.

Fallout

Monthly fallout samples are collected at the eight stations shown in figure 1. Due to the locations of the stations the measured activity may include both fallout from the atmosphere and activity resuspended because of the movement of vehicles and construction work. The results presented in table 3 reveal no substantial differences between upwind and downwind fallout rates.

Soil Sampling

Soil samples are collected during the second and fourth quarters each year. Beginning with the second quarter 1961 the number of sampling locations were increased from five to eleven as shown in figure 1. The second quarter average concentrations in soil based on the eleven samples were 87 $\mu\mu c$ α/gm and 23 $\mu\mu c$ β-γ/gm. Based on the original five stations the average concentrations were 70 $\mu\mu c$ α/gm and 19 $\mu\mu c$ β-γ/gm.

Shippingport Atomic Power Station

Duquesne Light Company, Shippingport, Pennsylvania
First and Second Quarters 1961

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959	July 1960
First quarter 1960	December 1960
Second quarter 1960	January 1961
Third and fourth quarters 1960	October 1961

The Shippingport Atomic Power Station operated for the Atomic Energy Commission by the Duquesne Light Company, is the world's first large-scale nuclear-powered electric generating station. The environmental radiation monitoring program was initiated two years prior to the beginning of plant operation in December 1957.

Release of Radioactive Wastes to the Atmosphere

During the second quarter 1961 a total of 84.9 millicuries of gaseous radioactive wastes (primarily xenon-133) was released to the atmosphere at a controlled rate over a period of 566 hours. This gaseous waste had an average concentration of 9,800 $\mu\mu c/m^3$ at the stack exit during release.

An incinerator for burning contaminated combustible material is located in the waste disposal plant. The exhaust from the incinerator passes through a wet gas scrubber and a filter before entering the stack.

During the first quarter 1961 the incinerator was operated on three occasions. The average radioactivity at the stock during operation was 34 $\mu\mu c/m^3$ (compare with table 1 line 7). The incinerator was not used during the second quarter 1961. Plans were under way to process and package all combustible radioactive wastes for shipment to Oak Ridge, Tennessee, for land burial.

Area Monitoring

Continuous weekly samples of airborne particulates are collected at four area monitoring stations shown in figure 2. Average concentrations of radioactivity in air for the first and second quarters 1961 are presented in table 4. These concentrations may be compared with table 1 line 7.

Beta-gamma radiation levels are also con-

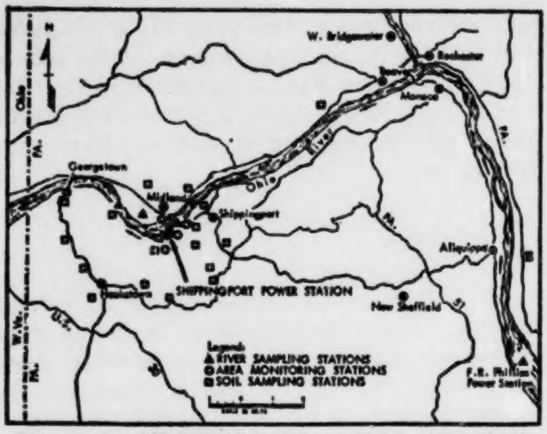

FIGURE 2.—SHIPPINGPORT POWER STATION, SAMPLING LOCATIONS

tinuously monitored at the four area monitoring stations. There was no significant difference in average levels among the four stations. The average beta-gamma level for each of the first two quarters of 1961 was 0.012 mrem/hr.

Weekly fallout samples are collected at the four area monitoring stations. The gross beta activity in fallout for the first and second quarters 1961 is given in table 5.

Liquid Radioactive Waste Monitoring

Tritium (H^3) is released periodically in controlled quantities and concentrations to the Ohio River. Toward the end of 1960 the ion exchange resin in the reactor coolant purification system was changed from a natural lithium hydroxyl form to a lithium-7 enriched form. This change has resulted in a decrease in tritium production within the reactor by a factor of about 30. The total tritium activities released to the Ohio River during the fourth quarter 1960 and first and second quarters 1961 were 51.3, 10.7, and 1.5 curies respectively. The average tritium concentrations in the plant effluent channel during tritium discharge were 7,200, 4,300, and 170 μμc/liter for the same three quarters.

TABLE 4.—AIRBORNE PARTICULATE RADIOACTIVITY

[Average concentrations in μμc/m³]

Sampling location	First quarter 1961	Second quarter 1961
Upwind:		
½ mi. SW of site	1.1	1.0
½ mi. NW of site	1.0	No data
Downwind:		
On site, SE of main bldg	0.7	0.6
½ mi. NE of site	1.1	1.0
Average of all stations	1.0	0.9

TABLE 5.—GROSS BETA ACTIVITY IN FALLOUT

[Average concentrations in mc/km²/month[a]]

Sampling location	First quarter 1961	Second quarter 1961
Upwind:		
½ mi. SW of site	1.2	0.6
½ mi. NW of site	1.5	1.0
Downwind:		
On site, SE of main bldg	1.3	0.8
½ mi. NE of site	1.7	0.8
Average of all stations	1.4	0.8

[a] One mc/km² = 2.59 mc/mi².

Gross radioactivity of unidentified nuclides (does not include tritium) discharged during the first and second quarters 1961 totaled 23.7 and 22.0 millicuries respectively. Average concentrations in the effluent channel during release were 4.3 and 2.2 μμc/liter. These concentrations are in addition to normal background radioactivity in the condenser cooling water used for dilution in the effluent channel prior to dischage to the Ohio River. Although the Plant has conservatively adopted the most restrictive MPC as its guide (see table 1 line 4), a less restrictive guide as in table 1 line 3 could be justified on the basis that radium-226 and radium-228 should not be expected from the type of operation at Shippingport.

Continuous weekly water samples are collected from four locations on the Ohio River, and a weekly grab sample is taken at dam #7. The stations are listed by name in table 6 and their locations shown in figure 2. The beta activity given in table 6 includes naturally-occurring potassium-40 which averaged 2.1 and 1.1 μμc/liter in the Ohio River during first and second quarters 1961 respectively.

TABLE 6.—GROSS ALPHA AND BETA CONCENTRATIONS IN THE OHIO RIVER

[Average concentrations in μμc/liter]

Sampling station	First quarter 1961		Second quarter 1961	
	Alpha	Beta	Alpha	Beta
Upstream:				
Phillips Power Station	0.9	7.1	1.2	9.2
Shippingport intake	1.0	7.4	[a] 1.5	6.9
Downstream:				
Shippingport outfall	1.0	15.9	[a] 1.4	8.3
Midland intake	1.5	11.8	1.1	8.4
Dam No. 7	[a] 1.0	8.4	[a] 1.4	7.8
East Liverpool, Ohio	1.6	8.8	0.7	6.8

[a] Weekly grab sample averages.

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Reported Nuclear Detonations

Radiological Health Data, Volume II, Numbers 10, 11, and 12, and Volume III, Numbers 1, 2, and 3, published summary information on the Union of Soviet Socialist Republics and the United States reported nuclear detonations through February 28, 1962. The following table gives information on the subsequent tests reported through March 31, 1962. Low yield range has been announced as meaning about a nominal (20 kiloton yield); low-intermediate to mean between a nominal and one megaton yield.

NUCLEAR TEST DETONATIONS REPORTED DURING MARCH 1962

Test number	Location	Date	Size	Type of test
20	Nevada Test Site	March 5	Low yield	Underground
21	Nevada Test Site	March 6	Low yield	Underground
22	Nevada Test Site	March 8	Low yield	Underground
23	Nevada Test Site	March 15	Low yield	Underground
24	Nevada Test Site	March 28	Low yield	Underground
25	Nevada Test Site	March 31	Low yield	Underground

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT MAY 1962 VOLUME III, NUMBER 5

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service • Division of Radiological Health

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UNITS AND EQUIVALENTS

For the convenience of the reader, a selected list of units and equivalents frequently used in *Radiological Health Data* (*RHD*) are presented below.

Symbol	Name of unit	Equivalents
cpm	count per minute.	
dpm	disintegration per minute.	
$\mu\mu c$	micromicrocurie	1 $\mu\mu c$ = 2.22 dpm.
mc/km^2	millicurie per square kilometer	1 mc/km^2 = 1000 $\mu\mu c/m^2$ = 2.59 mc/mi^2.
mi^2	square mile.	
m^2	square meter.	
m^3	cubic meter	1 m^3 = 1000 liters.
gm	gram.	
kg	kilogram	1 kg = 1000 gm.
mm	millimeter	precipitation: mm = $\frac{\mu\mu c/m^2}{\mu\mu c/liter}$
mr/hr	milliroentgen per hour.	

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SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations at urban locations operated by State and local health department personnel, except for 2 stations which were operated by Public Health Service personnel. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network was expanded over a period of a few months to 63 stations (see figure 1).

Air

Measurements of gross beta radioactivity in air at ground level are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological effects is not possible from these data alone.

Daily air samples are collected continuously by a high volume air sampler with a carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known radioactive source. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network for a more refined measurement using a thin-window gas flow proportional counter. The fission-product gross beta average concentrations in surface air during February 1962 are tabulated in table 1. The data shown represent the activities extrapolated to the time of collection.

Precipitation

Continuous sampling for total precipitation is conducted at each station on a daily basis using locally-made funnels having collection areas of 0.4 square meter (m^2). One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples.

The monthly averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$), are presented in table 2 for February 1962. The total precipitation for the month, expressed in millimeters (mm), may be computed directly from the data by

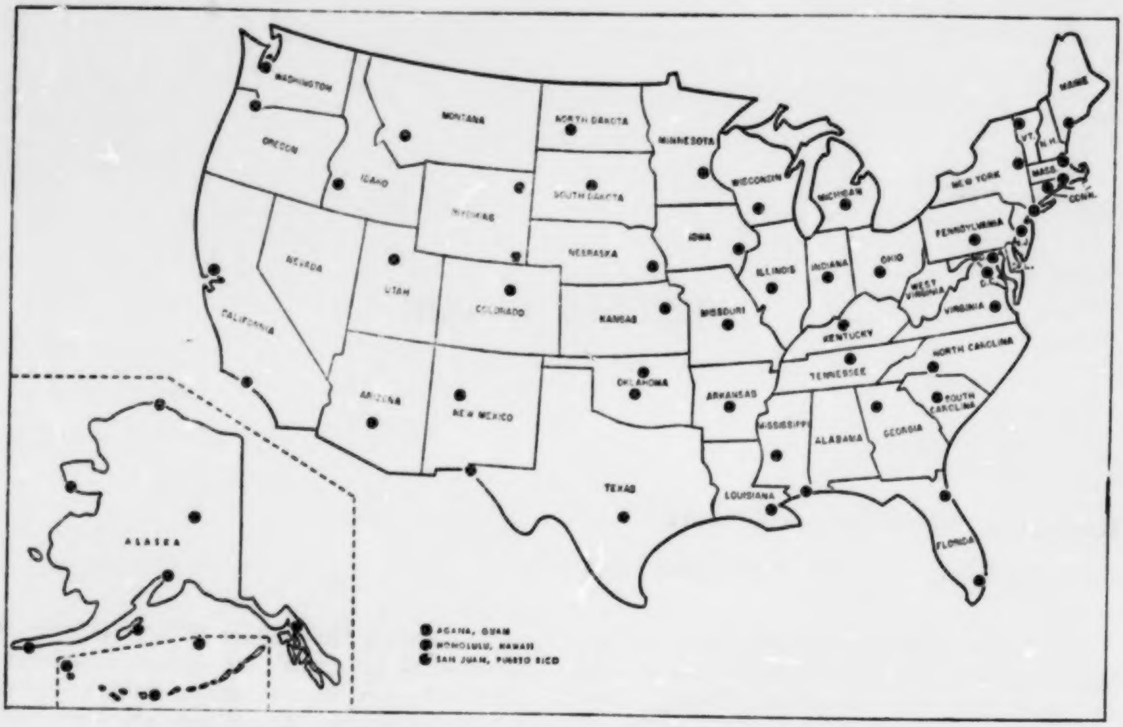
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VT.
N.H.
MAINE
MASS.
CONN.
D.C.
ALASKA
AGANA, GUAM
HONOLULU, HAWAII
SAN JUAN, PUERTO RICO

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS

using the following expression:

$$\text{Total precipitation (mm)} = \frac{\text{Total activity } (\mu\mu c/m^2)}{\text{Average concentration } (\mu\mu c/\text{liter})}$$

When the gross beta concentration of a given daily precipitation sample is too low for reliable measurement, an activity ($\mu\mu c/m^2$) calculated from the minimum level of detection is included in the monthly summation of activity. In the event that the sum of such "less-than" activities is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a less-than (<) sign.

Review: Concentration of Fission Products

Because of U.S.S.R. nuclear weapons testing during September, October, and November 1961, the four-month span from September through December provides some interesting observations.

Each of the seventeen maps in figure 2 shows the geographic distribution of the approximate concentrations of gross beta in air averaged over a seven-day period. Only one week showed concentrations exceeding 50 $\mu\mu c/m^3$. For further details, refer to the daily iso-concentration maps for September 16-27 in November 1961 *RHD*.

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TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, FEBURARY 1962

[Concentrations in μμc/m³]

City	State	Number samples	Maximum	Minimum	Average [1]	City	State	Number samples	Maximum	Minimum	Average [1]
Adak	Alaska..	16	5.3	0.30	2.3	Lansing	Mich....	28	17	3.6	8.1
Anchorage	Alaska..	19	14	1.1	5.1	Minneapolis	Minn....	17	4.3	1.8	3.7
Attu	Alaska..	19	7.0	0.20	2.3	Jackson	Miss.....	15	11	1.2	6.1
Cold Bay	Alaska..	17	3.5	<0.10	1.3	Pascagoula	Miss.....	19	14	2.9	7.9
Fairbanks	Alaska..	20	11	1.7	5.7	Jefferson City	Mo......	18	8.8	1.2	4.8
Juneau	Alaska..	19	19	3.0	9.0	Helena	Mont....	16	9.8	1.6	5.1
Kodiak	Alaska..	19	8.2	0.40	2.5	Lincoln	Nebr....	—	—	—	—
Nome	Alaska..	[b] —	—	—	—	Trenton	N. J......	17	11	0.27	4.6
Point Barrow	Alaska..	11	5.4	1.8	3.4	Santa Fe	N. Mex .	19	14	2.6	8.0
St. Paul Island	Alaska..	21	4.1	<0.10	2.0	Albany	N. Y....	18	8.6	0.87	5.6
Phoenix	Ariz......	9	13	1.9	5.8	New York	N. Y....	4	21	7.2	11
Little Rock	Ark......	18	10	1.9	5.4	Gastonia	N. C....	20	14	1.9	7.2
Berkeley	Calif....	18	10	1.4	5.1	Bismarck	N. D....	18	6.1	1.4	3.7
Los Angeles	Calif....	18	12	0.28	7.1	Columbus	Ohio....	18	16	2.6	8.0
Denver	Colo....	18	12	2.9	5.7	Oklahoma City	Okla....	18	13	3.0	[illegible]
Hartford	Conn....	16	8.1	0.81	5.3	Ponca City	Okla....	20	6.0	1.0	2.7
Washington	D. C....	27	13	0.60	6.1	Portland	Oreg....	19	18	1.9	7.3
Jacksonville	Fla......	18	12	2.5	9.4	Harrisburg	Pa.......	15	19	<0.10	9.2
Miami	Fla......	20	16	2.5	6.3	San Juan	P. R....	7	8.0	1.8	4.8
Atlanta	Ga......	17	12	1.9	6.0	Providence	R. I.....	18	10	2.5	6.3
Agana	Guam...	24	14	0.60	6.0	Columbia	S. C.....	19	9.2	1.3	5.3
Honolulu	Hawaii .	19	9.6	0.50	4.4	Pierre	S. D....	8	7.9	2.5	5.2
Boise	Idaho...	19	10	2.0	5.8	Nashville	Tenn....	15	11	0.38	6.8
Springfield	Ill.......	19	8.5	1.0	4.4	Austin	Tex.....	16	20	0.97	8.6
Indianapolis	Ind.....	18	13	1.2	4.8	El Paso	Tex.....	19	13	2.8	8.5
Iowa City	Iowa....	20	6.0	1.9	4.3	Salt Lake City	Utah....	19	9.0	1.8	8.1
Topeka	Kans....	19	9.5	1.5	5.1	Richmond	Va......	18	7.5	1.0	4.5
Frankfort	Ky......	18	18	0.88	7.1	Seattle	Wash....	18	16	0.40	4.3
New Orleans	La......	19	12	2.5	6.0	Madison	Wis.....	20	12	1.5	5.6
Augusta	Maine...	28	9.1	3.2	5.7	Cheyenne	Wyo.....	20	11	2.2	5.3
Baltimore	Md......	19	11	0.25	5.9	Sundance	Wyo.....	5	7.9	3.3	5.6
Lawrence	Mass....	19	8.2	1.9	5.1	Network average....	....	....	....	....	5.72

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, FEBRUARY 1962

Station location		Average concentration (μμc/liter)	Total activity (μμc/m³)	Station location		Average concentration (μμc/liter)	Total activity (μμc/m³)
City	State			City	State		
Adak	Alaska....	[a] —	—	Lansing	Mich......	1,180	49,500
Anchorage	Alaska....	730	7,700	Minneapolis	Minn......	1,500	30,400
Attu	Alaska....	—	—	Jackson	Miss.......	580	32,800
Cold Bay	Alaska....	—	—	Pascagoula	Miss.......	3,300	36,000
Fairbanks	Alaska....	1,500	41,700	Jefferson City	Mo.........	3,000	139,000
Juneau	Alaska....	1,600	55,100	Helena	Mont......	3,800	43,200
Kodiak	Alaska....	—	—	Lincoln	Nebr......	4,200	59,000
Nome	Alaska....	—	—	Trenton	N. J........	—	—
Point Barrow	Alaska....	—	—	Santa Fe	N. Mex....	14,000	17,000
St. Paul Island	Alaska....	—	—	Albany	N. Y.......	700	42,670
Phoenix	Ariz.......	—	—	New York	N. Y.......	—	—
Little Rock	Ark.......	1,100	219,000	Gastonia	N. C.......	930	87,090
Berkeley	Calif......	650	134,000	Bismarck	N. D.......	380	11,100
Los Angeles	Calif......	890	305,000	Columbus	Ohio......	2,267	119,500
Denver	Colo......	470	4,500	Oklahoma City	Okla......	1,200	38,500
Hartford	Conn......	2,200	130,900	Ponca City	Okla......	2,200	28,600
Washington	D. C......	1,600	136,300	Portland	Oreg......	1,400	58,800
Jacksonville	Fla........	1,500	18,800	Harrisburg	Pa.........	1,600	35,650
Atlanta	Ga........	950	135,800	San Juan	P. R.......	—	—
				Providence	R. I........	3,000	331,000
Agana	Guam.....	—	—	Columbia	S. C........	2,600	72,500
Honolulu	Hawaii....	1,200	82,000	Pierre	S. Dak....	700	34,900
Boise	Idaho.....	900	13,400	Nashville	Tenn......	1,000	206,700
Springfield	Ill..........	3,100	20,000	Austin	Tex........	2,500	44,000
Indianapolis	Ind........	2,100	90,100	El Paso	Tex........	1,000	15,000
Iowa City	Iowa......	2,900	173,700	Salt Lake City	Utah......	2,800	110,[illegible]
Topeka	Kans......	5,200	56,000	Richmond	Va.........	1,900	152,[illegible]
Frankfort	Ky........	1,100	66,200	Seattle	Wash......	1,600	31,20[illegible]
New Orleans	La........	1,200	84,700	Madison	Wis.......	1,700	60,80[illegible]
Augusta	Maine.....	1,200	42,100	Cheyenne	Wyo.......	1,000	10,300
Baltimore	Md........	—	—				
Lawrence	Mass......	1,300	50,700	Sundance	Wyo.......	—	—

[a] Dash denotes no sample received.

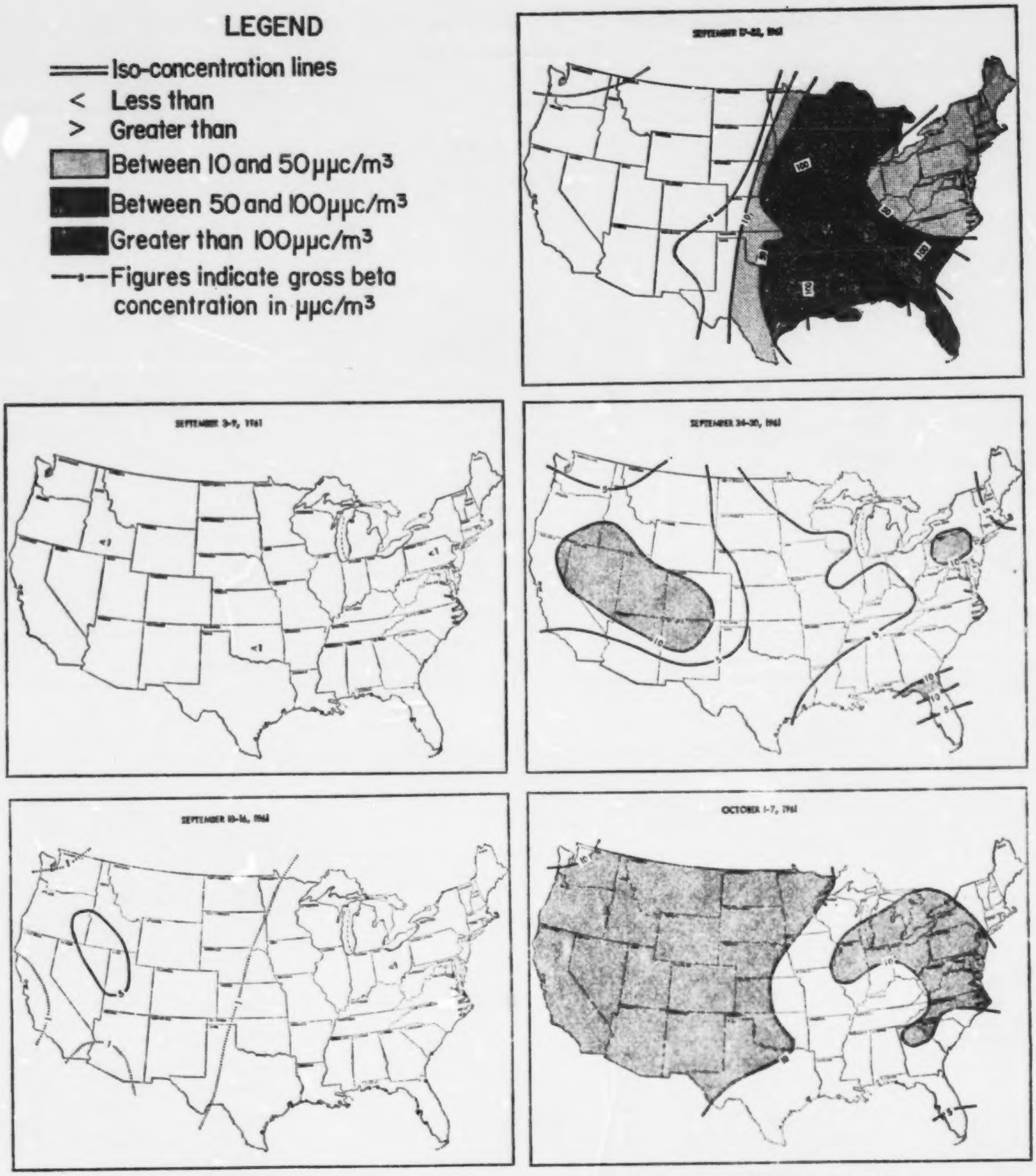
LEGEND
Iso-concentration lines
< Less than
> Greater than
Between 10 and 50 μμc/m3
Between 50 and 100 μμc/m3
Greater than 100 μμc/m3
Figures indicate gross beta concentration in μμc/m3
SEPTEMBER 17-23, 1961
SEPTEMBER 3-9, 1961
SEPTEMBER 24-30, 1961
SEPTEMBER 10-16, 1961
OCTOBER 1-7, 1961
100
50
10
5
<1

FIGURE 2.—WEEKLY AVERAGE GROSS BETA CONCENTRATIONS IN AIR, RADIATION SURVEILLANCE NETWORK, SEPTEMBER 3–DECEMBER 30, 1961

40<

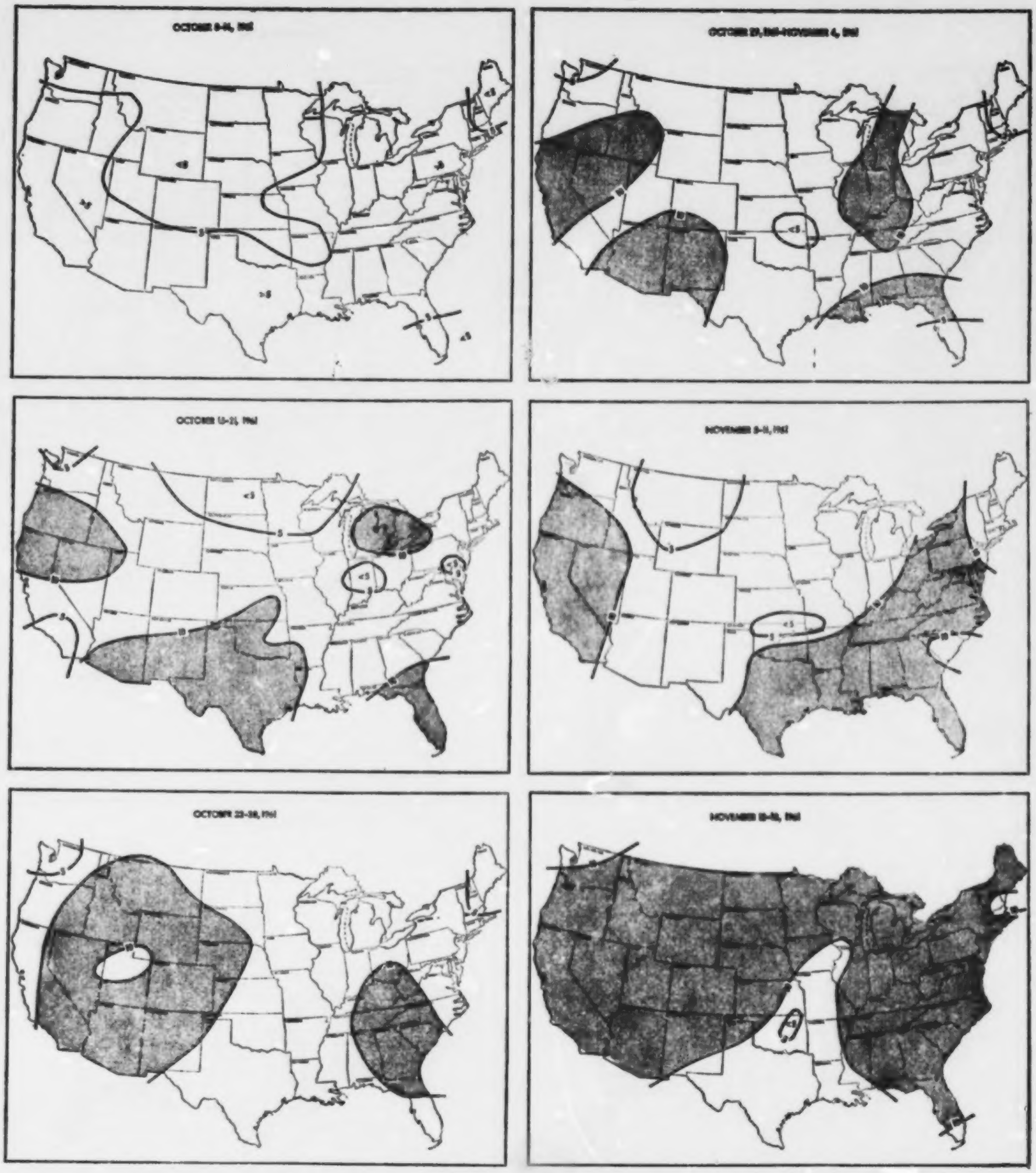
OCTOBER 8-14, 1961
OCTOBER 29, 1961-NOVEMBER 4, 1961
OCTOBER 15-21, 1961
NOVEMBER 5-11, 1961
OCTOBER 22-28, 1961
NOVEMBER 12-18, 1961

FIGURE 2.—WEEKLY AVERAGE GROSS BETA CONCENTRATIONS IN AIR, RADIATION SURVEILLANCE NETWORK, SEPTEMBER 3-DECEMBER 30, 1961—CONTINUED

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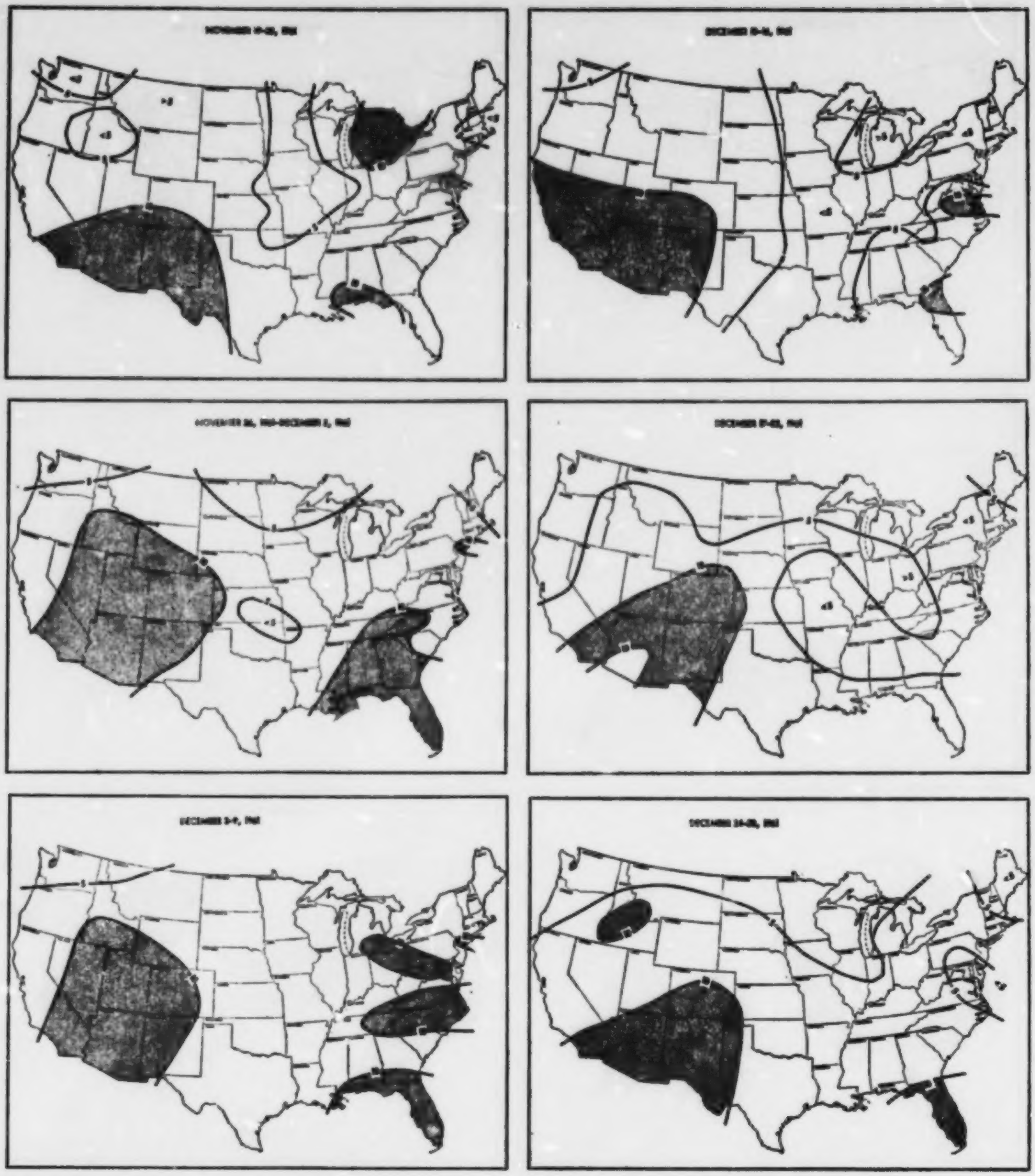

FIGURE 2.—WEEKLY AVERAGE GROSS BETA CONCENTRATIONS IN AIR, RADIATION SURVEILLANCE NETWORK, SEPTEMBER 3–DECEMBER 30, 1961—CONTINUED

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Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program for radon (Rn^{222}), thoron (Rn^{220}), and gross beta fission product concentrations in surface air. The gross beta activity of atmospheric particulates, when measured several days after sample collection, is principally due to artificially produced radionuclides.

Radon-222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter.

The data are now computed by an electronic data processing system which is programmed for thirteen four-week periods per calendar year. The data for the period January 29–February 23, 1962, appears in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, *22*, No. 1, Feb. 1961.

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT GROSS BETA CONCENTRATIONS AT CINCINNATI, OHIO, JANUARY 29–FEBRUARY 23, 1962

End of sampling period	Sample collection		Rn^{222} 8 a.m. (μμc/m³)	Rn^{222} 3 p.m.[a] (μμc/m³)	Rn^{220} (μμc/m³)	Beta activity (μμc/m³)
	Sample period (hours)	Volume (m³)				
January 29	71.8	88.4	120	160	1.1	9.54
30	24.0	29.9	170	120	0.8	10.45
31	23.9	29.7	160	30	1.2	5.32
February 1	24.4	30.1	200	90	1.1	9.15
2	23.6	29.1	130	100	0.5	8.03
5	71.9	87.0	280	80	1.8	10.08
6	23.9	29.9	80	80	0.5	5.37
7	23.9	30.0	190	100	1.0	5.48
8	23.9	29.9	180	150	1.2	9.94
9	23.9	29.8	190	140	1.4	22.40
12	71.9	86.5	320	130	1.4	11.40
13	23.9	29.4	220	190	0.5	13.79
14	23.9	29.3	130	130	0.7	9.05
15	23.9	29.5	100	90	0.5	2.63
16	23.9	29.7	120	130	0.9	9.16
19	71.9	87.2	180	120	1.4	3.27
20	23.9	29.8	50	30	0.5	3.65
21	23.9	30.0	100	120	1.4	12.64
23	47.9	59.4	110	120	0.9	7.54
Average			176	114	1.1	8.75
Range of counting errors (2σ)						
Maximum			32	24	0.5	0.28
Minimum			12	10	0.2	0.06

[a] Sample period and volume does not apply to this column.

Radioactivity Measurements in Surface Air Near The 80th Meridian (West)

U. S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian (West) have been made since 1956. Sampling locations are shown in figure 1. This program is operated by the U. S. Naval Research Laboratory (NRL) with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which have made the actual sample collections and forwarded them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U. S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously at a rate of approximately 1200 cubic meters per day through high efficiency filters, 8-inches in diameter, using positive displacement blowers. Due to the decrease of radioactivity levels during 1960 and 1961, it became necessary to change the sampling period from a daily to a weekly basis at most stations. After the sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

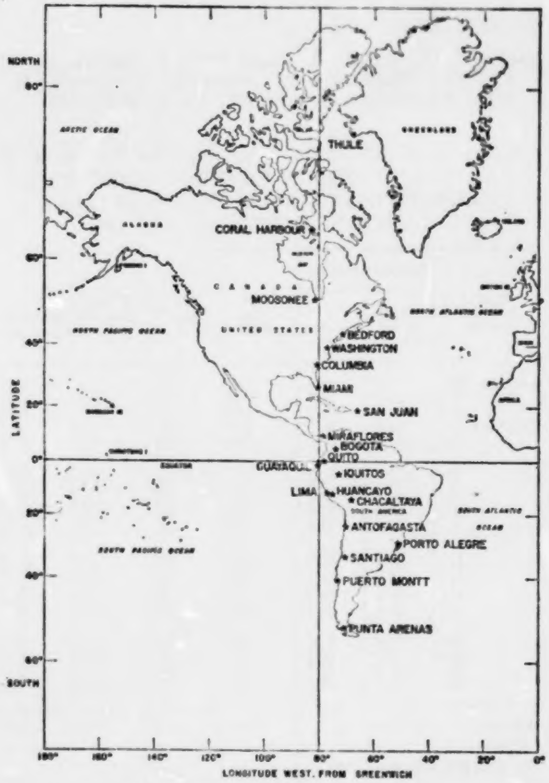
NORTH
80°
60°
40°
20°
0°
20°
40°
60°
SOUTH
LATITUDE
ARCTIC OCEAN
GREENLAND
THULE
ALASKA
CORAL HARBOUR
CANADA
MOOSONEE
NORTH ATLANTIC OCEAN
NORTH PACIFIC OCEAN
UNITED STATES
BEDFORD
WASHINGTON
COLUMBIA
MIAMI
SAN JUAN
MIRAFLORES
BOGOTA
QUITO
EQUATOR
GUAYAQUIL
IQUITOS
LIMA
HUANCAYO
CHACALTAYA
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
ANTOFAGASTA
PORTO ALEGRE
SOUTH PACIFIC OCEAN
SANTIAGO
PUERTO MONTT
PUNTA ARENAS
180°
160°
140°
120°
100°
80°
60°
40°
20°
0°
LONGITUDE WEST, FROM GREENWICH

FIGURE 1.—ATMOSPHERIC RADIOACTIVITY SAMPLING STATIONS NEAR THE 80TH MERIDIAN WEST

Fission product beta concentrations during January 1962 are reported in table 1 somewhat differently than were earlier data from this program. Each sample is represented by a rectangle whose boundaries indicate station, length of sampling period, and dates of sampling. The average gross beta concentration in micromicrocuries per cubic meter (formerly reported as disintegrations per minute per cubic meter) for each sampling period appears within the appropriate rectangle. Beginning with the January data, the gross beta concentrations reflect recent recalibration of the equipment.

Radiochemical analyses are performed on monthly composite air-filter samples for the following nuclides: strontium-89, strontium-90, yttrium-91, cesium-137, cerium-141, cerium-144, promethium 147, tungsten-185, and lead-210. The 1960 analyses were reported in the March 1962 *Radiological Health Data.* The 1961 analyses will be reported in a future issue.

The gross β measurements indicate that radioactive debris from the 1961 Soviet nuclear test series appeared at Guayaquil, Ecuador during January 1962; these measurements are not sufficiently specific, however, to prove the presence of Soviet debris at other Southern Hemisphere sites. Radiochemical analyses which are highly specific for the short-lived fission products produced in the USSR explosions have just been completed for the isotope Ce^{141} in some of the air filter samples collected along the 30th meridian during November and December 1961. Small but identifiable quantities of Ce^{141} (33 day half-life) have been found as far south as Santiago, Chile in a concentration range in the order of 1–2%

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TABLE 1.—FISSION-PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, NRL, JANUARY 1962[a]

[Average concentrations in $\mu\mu c$/liter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Can. Z.	San Juan, P. R.	Mauna Loa,[b] Hawaii	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1	0.018	0.034	0.050	0.112	0.035	0.090	0.168	1.30	1.72	4.39	11.25	3.89	3.38	—
2	0.004	0.027	0.069	—[c]	0.010		0.112		4.97	1.95	7.56	7.02	2.82	
3						0.007		1.65					4.73	
4													2.27	
5														
6													2.95	
7													4.47	
8													7.46	
9	0.014	0.024	0.065	0.139	0.031	0.049	0.276	6.25	6.20	5.50	9.32	6.39	4.31	4.54
10													3.84	5.31
11													6.00	
12													7.82	
13													5.49	
14													5.64	
15													4.32	
16	0.055	0.023	0.063	0.059	0.061	0.026	0.523	4.36	5.02	2.99	8.73	6.84	3.65	
17														6.57
18														
19														
20														
21														
22														
23	0.027	0.067	—	0.084	0.026	0.065	0.394	3.26	4.71	3.09	6.21	8.37	3.24	
24														3.16
25														
26														
27														
28														
29	—													
30	0.024	—	0.103	0.079	0.026	0.038	0.828	2.59	3.88	1.30	8.01	5.54	2.74	
31														4.49
Mean	0.025	0.035	0.068	0.093	0.032	0.041	0.354	3.70	5.02	3.28	8.06	6.93	3.92	4.97

[a] Average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample averages according to the number of days in the sampling period or that portion of the sampling period occurring in January 1962.

[b] Mauna Loa data has been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally-distant north and south of the equator.

[c] Dash indicates sample was not received because of motor, filter, or other mechanical failure.

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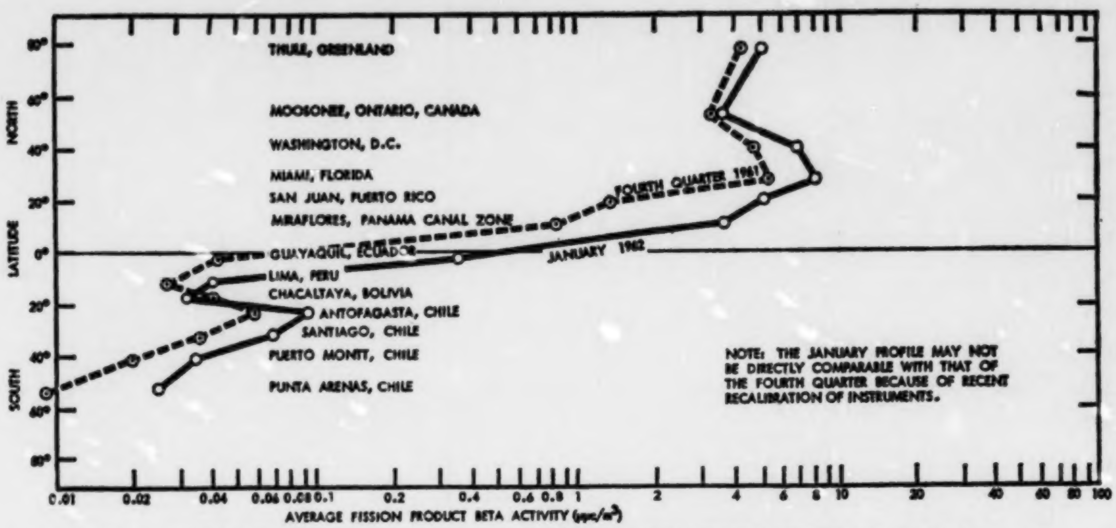
of that found in the Northern Hemisphere. This isotope has not been detected in the Southern Hemisphere since the Spring of 1960, following the detonation of the first French nuclear device in the Sahara Desert. It is reasonable to assume that the same interhemispheric mixing processes that brought debris from the French test into the Southern Hemisphere can transport across the equator a portion of the debris from the Soviet tests that other processes have carried to the lower latitudes of the Northern Hemisphere.



NOTE: THE JANUARY PROFILE MAY NOT BE DIRECTLY COMPARABLE WITH THAT OF THE FOURTH QUARTER BECAUSE OF RECENT RECALIBRATION OF INSTRUMENTS.

FIGURE 2.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN WEST, FOURTH QUARTER 1961

Canadian Radioactive Fallout Monitoring Program

Department of National Health and Welfare, Dominion of Canada

Third quarter 1961

As part of its Radioactive Fallout Monitoring Program (RFMP), the Radiation Protection Division, Department of National Health and Welfare, Dominion of Canada, samples air, precipitation, and dried milk products. The discussion and results of the milk sampling program appear in Section II.

The nationwide air sampling program is conducted for two main purposes: (1) To provide a convenient method for the early detection of changes in the fission product concentration in the air and therefore of likely changes in the deposition of fission products on the ground, and (2) To obtain data to show the day-to-day and station-to-station variations in fission product concentrations as this may be useful to meteorologists in obtaining a better understanding of the mechanisms involved in radioactive fallout distribution in the atmosphere.

A more detailed discussion of the sampling procedures, methods of analysis, and interpretation of results of the Department's radioactive fallout program is contained in the "Annual Report for 1959," Report Number CNHW (RP–3).

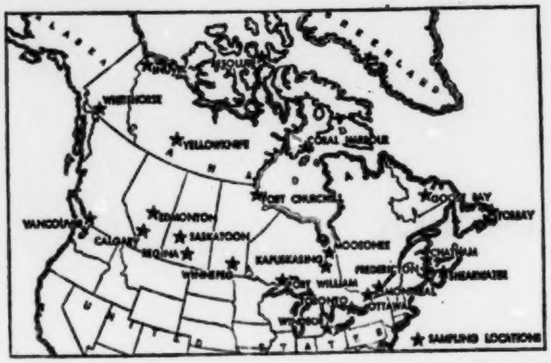


FIGURE 1.—CANADIAN AIR AND PRECIPITATION SAMPLING STATIONS

Previous coverage in *Radiological Health Data*

Period	*Issue*
July 1959–June 1960	January 1961
Third qaurter 1960	April 1961
Fourth quarter 1960	August 1961
First quarter 1961	December 1961
Second quarter 1961	February 1962

Tables 1 and 2 show the higher fission product levels in air and precipitation during September as a result of the U.S.S.R. nuclear weapons testing during that month. Note that the precipitation data are now given in micromicrocuries per liter (μμc/liter) and micromicrocuries per square meter (μμc/m²). [*To convert to other units such as millimeters of precipitation or millicuries per square mile (mc/mi²), see table of Units and Equivalents on page ii.*]

TABLE 1.—FISSION PRODUCT GROSS BETA ACTIVITY IN SURFACE AIR, RFMP, THIRD QUARTER 1961

[Average concentrations in μμc/m³]

Station location	July	August	September
Calgary	0.16	0.08	5.9
Chatham	0.13	0.06	20.2
Coral Harbour	0.10	0.08	3.2
Edmonton	0.17	0.07	10.0
Ft. Churchill	0.10	0.04	3.2
Ft. William	0.14	0.06	41.1
Fredericton	0.12	0.04	17.4
Goose Bay	0.10	0.06	9.2
Inuvik	0.11	0.04	8.9
Kapuskasing	0.17	0.07	47.7
Montreal	0.14	0.07	26.8
Moosonee	0.09	0.06	36.8
Ottawa	0.12	0.08	32.6
Regina	0.17	0.08	11.3
Resolute	0.06	0.02	1.7
Saskatoon	0.14	0.05	14.1
Shearwater	0.12	0.04	21.7
Torbay	0.10	0.07	13.5
Toronto	0.15	0.07	36.3
Vancouver	0.09	0.05	4.4
Whitehorse	0.10	0.05	3.9
Windsor	0.16	0.09	27.8
Winnepeg	0.18	0.09	12.0
Yellowknife	0.17	0.07	14.5
Maximum Station Average	0.17	0.09	47.7
Minimum station average	0.06	0.02	1.7
Overall average	0.13	0.06	17.7

TABLE 2.—FISSION PRODUCT GROSS BETA ACTIVITY IN PRECIPITATION, RFMP, THIRD QUARTER 196

Station location	July		August		September	
	Concentration (μμc/liter)	Deposition (μμc/m²)	Concentration (μμc/liter)	Deposition (μμc/m²)	Concentration (μμc/liter)	Deposition (μμc/m²)
Calgary	25.8	3,900	40.0	1,100	2,070	70,000
Chatham	56.3	1,800	16.7	1,200	511	29,400
Coral Harbour	71.4	1,100	16.7	700	73	5,200
Edmonton	31.9	3,000	491	2,700	4,030	104,000
Fredericton	31.9	2,000	18.2	1,600	304	23,200
Ft. Churchill	80.5	3,200	63.8	2,100	9,950	594,000
Ft. William	25.9	3,100	56.2	2,400	1,390	216,000
Goose Bay	10.7	1,900	22.8	1,500	541	44,800
Inuvik	35.0	1,200	30.4	1,500	9,870	74,900
Kapuskasing	22.8	3,300	19.8	2,200	2,700	399,000
Montreal	10.6	700	3.0	500	—	—
Moosonee	[a] —	—	41.0	3,000	2,800	201,000
Ottawa	38.0	2,100	28.9	2,800	821	37,600
Regina	68.4	1,700	629	1,100	1,750	22,700
Resolute	53.2	2,500	—	—	—	—
Saskatoon	24.4	1,600	1,670	1,700	2,470	52,100
Shearwater	33.4	1,700	—	—	681	42,200
Torbay	27.4	1,100	16.7	600	564	28,800
Toronto	38.0	3,000	73.0	2,900	664	28,300
Vancouver	22.8	900	33.4	1,400	5,110	241,000
Whitehorse	53.2	1,300	24.3	800	856	27,200
Windsor	19.8	1,400	24.3	3,900	278	32,000
Winnipeg	31.9	2,700	465	1,900	616	36,000
Yellowknife	35.0	2,000	18.3	350	1,680	61,000
Average	36.9	2,050	173	1,740	2,260	108,500

[a] Dash denotes no sample.

SECTION II.—MILK

Milk Monitoring Program

Division of Radiological Health
Division of Environmental Engineering and Food Protection,
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of the milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *RHD* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During December 1961, the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who shipped samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 states generally east of the Mississippi River, and the latter analyzes samples from the western states. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all states and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions.

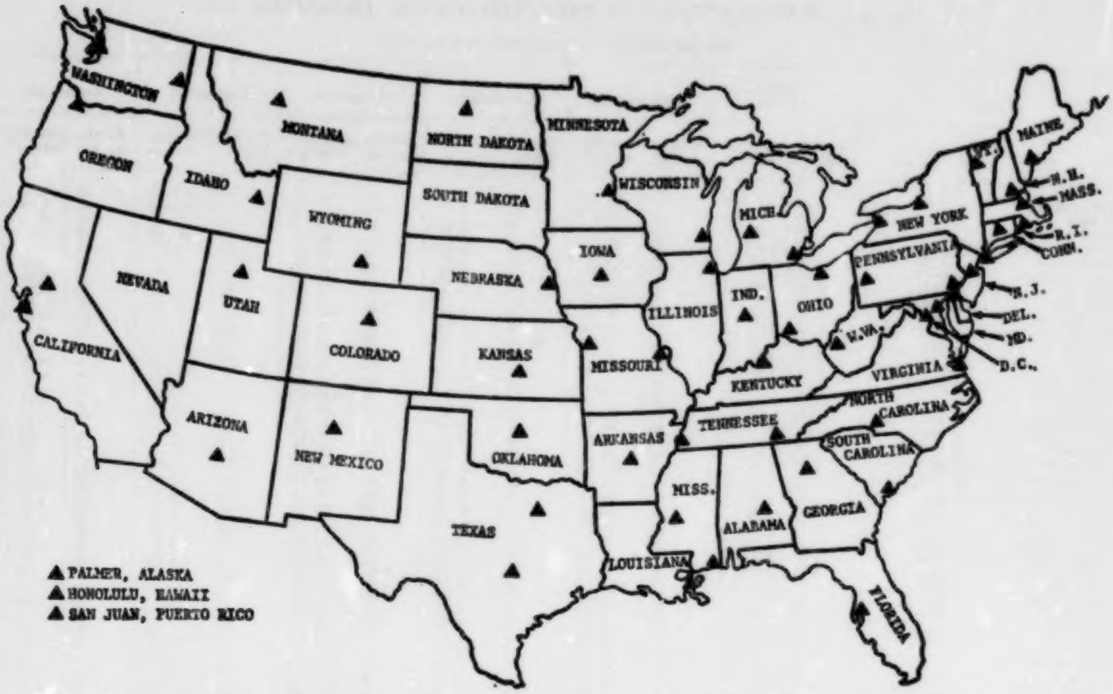

WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICH.
IND.
OHIO
KENTUCKY
TENNESSEE
MISS.
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
W.VA.
PENNSYLVANIA
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
N.J.
DEL.
MD.
D.C.
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, DECEMBER 1961

Editor's note: Rapid City, South Dakota, became a reporting station during April. It will not be indicated on figure 1 until the analytical data are available.

Since September 15, the sampling schedule has been accelerated.

During the second week in September, when increased levels of gross beta radioactivity in air were reported by the Radiation Surveillance Network, the frequency of milk sampling was accelerated at selected stations. Daily sampling of pasteurized milk, with analyses for iodine-131 content, was initiated on September 19, 1961, at six selected stations. These stations are maintained on a daily basis so that the pattern of variation in the iodine-131 content of milk may be carefully studied.

The sampling schedule in effect during the month of December was a transition between the November schedule (see April *RHD*) and the January 1962 schedule of weekly samples at all stations excepting the following which were maintained on the daily basis:

Chicago, Ill.	New York, N. Y.
New Orleans, La.	Austin, Tex.
St. Louis, Mo.	Seattle, Wash.

All surveillance data will be subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Iodine-131, cesium-137, and barium-140 are determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum levels of detection for strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 in terms of μμc/liter are 5, 1, 10, 5 and 10, respectively.

A comparison was made of cesium-137 concentrations in milk to show that they remain quite constant through the month. A number of milk samples collected during November from locations with high (90 μμc/liter), medium (20 μμc/liter), and low (5 μμc/liter)

TABLE 1.—RADIOACTIVITY IN PASTURIZED MILK, DECEMBER 1961

[Average radioactivity concentrations in μμc/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Fourth quarter	Monthly[a] average	Fourth quarter	Monthly[a] average	Fourth quarter	Monthly[a] average	Fourth quarter	Monthly[a] average	Fourth quarter	Monthly[a] average	Fourth quarter	Monthly[a] average
Montgomery	Ala.	1.22	1.18 (1)	10	20 (1)	6	6 (1)	20	<10 (1)	<5	<5 (1)	10	<10 (1)
Palmer	Alaska	1.10	1.04 (5)	60	20 (5)	12	9 (5)	130	<10 (6)	15	10 (5)	40	<10 (6)
Phoenix	Ariz.	1.05	1.01 (3)	10	20 (3)	6	2 (3)	30	10 (7)	5	5 (7)	<10	<10 (7)
Little Rock	Ark.	1.20	1.22 (5)	70	55 (5)	15	17 (6)	100	20 (9)	20	20 (1)	20	40 (6)
Sacramento	Calif.	1.13	1.11 (3)	10	10 (3)	5	3 (3)	20	10 (7)	10	5 (7)	<10	10 (7)
San Francisco	Calif.	1.09	1.10 (4)	10	15 (4)	3	4 (4)	20	<10 (5)	5	5 (5)	<10	<10 (5)
Denver	Colo.	1.10	1.08 (3)	20	25 (3)	6	7 (3)	50	10 (7)	10	5 (7)	10	<10 (7)
Hartford	Conn.	1.17	1.16 (5)	25	10 (5)	8	7 (5)	30	<10 (5)	10	<5 (1)	20	<10 (5)
Wilmington	Del.	1.17	1.20 (5)	50	20 (5)	10	9 (5)	40	<10 (6)	5	<5 (1)	20	10 (5)
Washington	D. C.	1.17	1.16 (4)	35	20 (4)	9	5 (4)	30	10 (6)	5	<5 (1)	20	<10 (4)
Tampa	Fla.	1.22	1.21 (5)	20	10 (5)	6	7 (5)	30	20 (7)	70	40 (1)	30	<10 (5)
Atlanta	Ga.	1.20	1.21 (5)	20	40 (5)	11	12 (5)	50	30 (7)	[b] 5	<5 (1)	30	30 (5)
Honolulu	Hawaii	1.07	1.05 (4)	10	20 (4)	6	11 (4)	20	10 (6)	15	10 (6)	<10	<10 (6)
Idaho Falls	Idaho	1.05	1.03 (4)	25	5 (4)	6	6 (4)	80	10 (6)	10	5 (6)	10	<10 (6)
Chicago	Ill.	1.17	1.16 (5)	35	15 (5)	7	7 (5)	70	<10(20)	[b] 10	<5 (1)	30	<10 (5)
Indianapolis	Ind.	1.21	1.20 (4)	40	20 (4)	8	10 (4)	50	10 (6)	<5	<5 (1)	20	10 (4)
Des Moines	Iowa	1.06	1.04 (4)	65	50 (4)	11	8 (4)	160	20 (9)	10	5 (9)	20	10 (5)
Wichita	Kans.	1.08	1.00 (3)	40	40 (3)	10	10 (3)	100	20(11)	10	10 (7)	10	10 (6)
Louisville	Ky.	1.19	1.19 (5)	45	50 (5)	10	11 (5)	60	20 (7)	<5	<5 (1)	30	20 (5)
New Orleans	La.	1.26	1.28 (5)	110	205 (5)	15	17 (5)	60	30(20)	15	10 (1)	40	40 (5)
Portland	Maine	1.19	1.15 (4)	60	<5 (4)	11	11 (4)	50	<10 (5)	20	20 (1)	40	<10 (4)
Baltimore	Md.	1.17	1.18 (5)	35	30 (5)	8	8 (5)	40	10 (6)	<5	<5 (1)	20	<10 (5)
Boston	Mass.	1.18	1.19 (5)	70	<5 (5)	11	11 (5)	60	10 (6)	10	10 (1)	40	<10 (5)
Detroit	Mich.	1.17	1.15 (5)	45	15 (5)	7	6 (5)	100	<10 (6)	5	<5 (1)	20	<10 (6)
Grand Rapids	Mich.	1.19	1.22 (5)	60	15 (5)	7	7 (5)	30	<10 (6)	<5	<5 (1)	30	10 (5)
Minneapolis	Minn.	1.10	1.14 (3)	110	20 (4)	12	10 (4)	170	10 (9)	15	10 (7)	40	<10 (7)
Jackson	Miss.	1.26	1.31 (5)	95	175 (5)	14	17 (5)	70	50 (8)	5	<5 (1)	60	30 (5)
Pascagoula	Miss.	1.27	1.26 (5)	80	145 (5)	16	18 (5)	80	40 (6)	10	10 (1)	30	30 (5)
Kansas City	Mo.	1.06	1.07 (3)	75	70 (3)	10	12 (3)	130	40 (6)	15	10 (6)	20	10 (6)
St. Louis	Mo.	1.09	1.02 (4)	35	20 (4)	9	8 (4)	90	10(23)	10	10(23)	10	<10(23)
Helena	Mont.	1.0[illegible]	1.02 (2)	15	5 (2)	8	6 (2)	100	20 (7)	20	15 (5)	10	<10 (5)
Omaha	Nebr.	1.05	1.01 (4)	100	70 (4)	10	7 (4)	140	40 (9)	10	10 (6)	30	10 (6)
Manchester	N. H.	1.20	1.20 (5)	35	5 (5)	12	12 (5)	80	<10 (6)	25	20 (1)	60	<10 (5)
Trenton	N. J.	1.18	1.17 (4)	35	15 (4)	9	8 (4)	40	<10 (6)	<5	<5 (1)	20	20 (4)
Albuquerque	N. Mex.	1.09	1.10 (3)	5	10 (4)	6	4 (4)	30	<10 (6)	10	5 (6)	<10	<10 (6)
Buffalo	N. Y.	1.12	1.11 (5)	35	5 (5)	8	8 (5)	40	<10 (6)	5	10 (1)	20	<10 (5)
New York	N. Y.	1.13	1.12 (5)	40	5 (5)	8	9 (5)	50	<10(19)	5	<5 (1)	30	<10 (5)
Syracuse	N. Y.	1.16	1.13 (5)	50	5 (5)	8	7 (5)	60	<10 (5)	10	<5 (1)	30	<10 (5)
Charlotte	N. C.	1.27	1.29 (5)	25	30 (5)	10	12 (5)	20	<10 (7)	<5	<5 (1)	10	10 (5)
Minot	N. D.	1.09	1.04 (4)	15	5 (4)	11	11 (4)	60	<10 (5)	10	10 (5)	<10	<10 (5)
Cincinnati	Ohio	1.22	1.21 (5)	50	50 (5)	8	10 (8)	70	20 (7)	<5	<5 (1)	20	10 (5)
Cleveland	Ohio	1.18	1.17 (5)	35	10 (5)	7	7 (5)	50	<10 (7)	5	<5 (1)	20	<10 (5)
Oklahoma City	Okla.	1.18	1.19 (5)	60	70 (5)	8	9 (5)	100	40 (5)	10	<5 (1)	20	30 (5)
Portland	Oreg.	1.05	1.02 (4)	70	20 (4)	17	6 (4)	80	10 (6)	25	20 (6)	20	10 (6)
Philadelphia	Pa.	1.20	1.19 (5)	30	10 (5)	5	9 (5)	40	<10 (6)	<5	<5 (1)	10	10 (5)
Pittsburgh	Pa.	1.16	1.18 (5)	40	5 (5)	10	10 (5)	40	<10 (6)	5	<5 (1)	30	10 (5)
San Juan	P. R.	1.18	1.17 (5)	55	130 (5)	5	5 (5)	20	30 (7)	10	30 (1)	20	30 (5)
Providence	R. I.	1.18	1.17 (5)	55	15 (5)	9	9 (5)	40	<10 (6)	10	10 (1)	30	<10 (5)
Charleston	S. C.	1.23	1.26 (4)	15	15 (4)	11	12 (4)	30	10 (5)	20	20 (1)	20	20 (4)
Chattanooga	Tenn.	1.27	1.31 (5)	50	80 (5)	12	16 (5)	50	30 (6)	5	<5 (1)	20	20 (5)
Memphis	Tenn.	1.24	1.24 (5)	60	85 (5)	11	12 (5)	90	40 (5)	10	10 (1)	30	20 (5)
Austin	Tex.	1.18	1.21 (5)	30	65 (5)	5	6 (5)	40	20(19)	[b] <5	<5 (1)	20	20 (5)
Dallas	Tex.	1.23	1.23 (5)	45	60 (5)	9	8 (5)	50	10 (9)	[b] <5	<5 (1)	20	20 (5)
Salt Lake City	Utah	1.11	1.00 (1)	20	15 (1)	5	5 (1)	60	10 (7)	10	10 (5)	10	<10 (5)
Burlington	Vt.	1.18	1.19 (4)	40	5 (4)	9	8 (4)	50	<10 (4)	10	10 (1)	20	<10 (4)
Norfolk	Va.	1.23	1.23 (5)	60	40 (5)	10	11 (5)	40	10 (6)	5	<5 (1)	20	10 (5)
Seattle	Wash.	1.11	1.07 (4)	60	30 (4)	14	8 (4)	80	10(28)	20	15(22)	20	10(22)
Spokane	Wash.	[b] 1.12	1.07 (3)	[b] 10	5 (3)	[b] 6	7 (3)	60	<10 (7)	15	10 (7)	10	10 (7)
Charleston	W. Va.	1.17	1.18 (5)	55	20 (5)	10	11 (5)	30	<10 (6)	<5	<5 (1)	20	10 (5)
Milwaukee	Wis.	1.17	1.06 (5)	35	5 (5)	7	6 (5)	80	<10 (8)	15	20 (1)	20	10 (5)
Laramie	Wyo.	1.09	1.06 (3)	<5	5 (3)	6	5 (3)	30	10 (8)	15	15 (8)	10	10 (8)
Network average		1.16	1.15	43	34	9	9	61	14	11	8	22	12

[a] Numbers in parentheses indicate total number of analyses reported during the month.
[b] Average based on two months.

concentrations were analyzed. The data indicate that cesium-137 levels remain quite constant throughout the month. Therefore, many sampling locations will have only one analysis performed each month for cesium-137.

The strontium-89 concentrations in milk decreased markedly during December in the Northeast and North Central States, but increased in the Southeast, possibly reflecting that dairy cattle in the Northeast and North Central States were taken off pasture feeding and put on feeds harvested prior to the resumption of atmospheric testing. The iodine-131 and barium-140 concentrations continued their decline from previous months while the average strontium-90 concentration for the network did not change.

Figure 2 is a graphical presentation of the average monthly concentrations of strontium-90 in pasteurized milk from selected cities representing the population centers of the four major geographic regions of the United States.

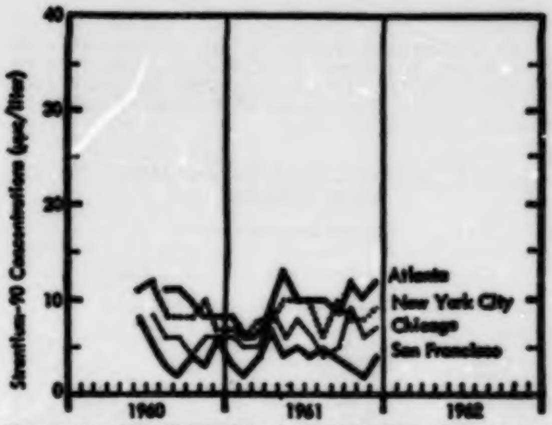


FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK, JUNE–DECEMBER 1961

These regions correspond to those used by the Department of Agriculture for their tabulations of average "per person" quantities of foods consumed per week, as presented in the September and October 1960 *RHD.*

Table 1 presents a summary of all available analyses for December. The numbers in parentheses indicate the number of samples involved in each average, and are a guide to the reliability of the average for the month. When a radionuclide was not detectable, one half of the minimum level of detection was used for averaging.

Strontium-90 in Canadian Dried Milk Products

Department of National Health and Welfare, Ottawa, Canada

In November 1955, radiochemical analyses of skim milk and buttermilk powders for strontium-90 concentrations were initiated by the Department of National Health and Welfare. Through the cooperation of the Marketing Division of the Canadian Department of Agriculture, dairy products inspectors collect four 1-pound samples of dried milk each month from each station (see figure 1) for the Radioactive Fallout Monitoring Program. No precise control is maintained over the method of sample collection. Whether or not all samples are collected on the same day or if the sample is truly representative of the milk produced in a given area is not known.

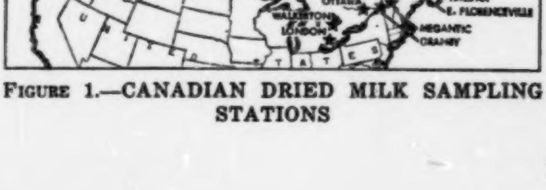


FIGURE 1.—CANADIAN DRIED MILK SAMPLING STATIONS

Because of the sampling uncertainties introduced by the method of sampling, the significance of differences between results from station-to-station and month-to-month are not precisely known. It is possible, however, to consider all the results for a given period of time as being sufficiently random in selection to show any national trend when the average values for such periods and all stations are plotted. Such a plot is shown in figure 2. It should be emphasized that average levels over a considerable period of time are more meaningful from the public health point of view than fluctuating monthly levels.

A detailed discussion of the sampling and radiochemical methodology may be found in the Department's publication (*1*).

Table 1 presents the results of measurements of strontium-90 in Canadian dried milk

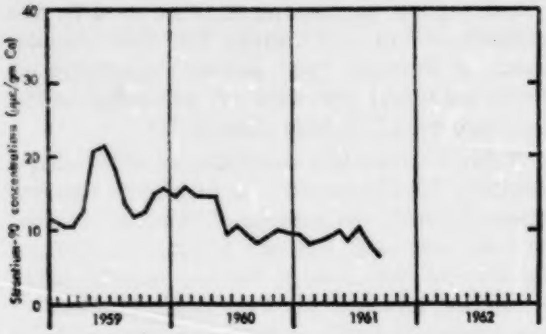


FIGURE 2.—AVERAGE STRONTIUM-90 CONCENTRATIONS IN CANADIAN DRIED MILK PRODUCTS

powder for the third quarter of 1961. This table was taken from the "Quarterly Report of the Radioactive Fallout Monitoring Program," dated January 1962, published by the Radiation Protection Division of the Department of National Health and Welfare. Monthly data for the years 1960 and 1961 have been published in previous issues of *Radiological Health Data.*

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(*1*) "Preliminary Report on the Measurements of Radioactive Strontium in Canadian Milk Powder Samples," *CNHW (RP-1)*, July 1958, Radiation Protection Division, Department of National Health and Welfare, Ottawa, Canada.

TABLE 1.—STRONTIUM-90 IN CANADIAN DRIED MILK POWDER, 1961

[Concentrations in μμc/gm Ca]

Station	Type of milk	July	August	September
Calgary	Skim	5.9	5.6	4.6
Charlottetown	Skim	[1] NS	NS	NS
Chicoutimi [2]	Skim	15.7	14.4	14.3
E. Florenceville	Skim	16.2	9.8	NS
Edmonton	Skim	6.9	5.8	4.2
Granby	Skim	11.6	12.4	7.8
Halifax	Skim	11.4	7.3	7.1
La Durantaye	Skim	15.0	11.4	9.8
London	Skim	4.1	2.8	2.3
Megantic	Skim	18.4	12.0	11.1
Moncton	Buttermilk	10.3	8.2	7.0
Ottawa	Skim	6.2	4.9	3.5
Saskatoon	Buttermilk	5.4	3.0	3.0
Sussex	Skim	10.5	9.4	7.6
Vancouver	Skim	10.6	5.6	5.7
Walkerton	Skim	4.4	5.5	3.3
Winnipeg	Buttermilk	NS	3.5	3.5
Average		10.2	7.6	6.3

[1] NS = no milk powder received for the month.

[2] Chicoutimi stopped production. Milk powder sampled from Mistassini on opposite shore of Lac St. Jean.

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SECTION III.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provision of Section 4 (c) of the Federal Water Pollution Control Act, which states ". . . The Secretary shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. During November 1961, 94 sampling stations submitted water samples for analyses. These stations are located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear weapons testing in the atmosphere by the U.S.S.R. has resulted in an increase in radioactivity of surface waters.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	November 1961					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa.	0.3	0	12	12	0	0	0
Animas River: Cedar Hill, N. Mex.	0.3	8	30	38	1	8	9
Apalachicola River: Chattahoochie, Fla.	0.4	16	30	46	0	0	0
Arkansas River:							
Coolidge, Kansas	2.3	28	81	109	5	76	81
Ponca City, Okla.	[a] —	122	87	209	1	4	5
Pendleton Ferry, Ark.	—	74	24	98	7	0	7
Big Sioux River: Sioux Falls, S. Dak.	0.4	53	127	180	2	2	4
Chattahoochie River:							
Atlanta, Ga.	—	4	5	9	0	0	0
Columbus, Ga.	—	1	5	6	0	0	0
Clear Water River: East Lewiston, Idaho	—	16	28	44	<1	<1	<1
Colorado River:							
Loma, Colo.	—	36	48	84	7	8	15
Boulder City, Nev.	1.0	7	13	20	<1	9	9
Parker Dam, Calif.	—	2	34	36	0	9	9
Yuma, Ariz.	—	30	66	96	2	0	2
Columbia River:							
Wenatchee, Wash.	—	2	7	9	0	1	1
Pasco, Wash.	1.1	61	687	748	0	0	0
Bonneville Dam, Oreg.	[b] 0.6	20	249	269	—	—	—
Clatskanie, Oreg.	—	14	155	169	—	—	—
McNary Dam, Oreg.	1.2	50	440	490	0	1	1
Connecticut River: Northfield, Mass.	0.4	6	16	22	0	0	0
Cumberland River: Clarksville, Tenn.	0.4	4	10	14	0	0	0
Delaware River:							
Martins Creek, Pa.	—	10	18	28	0	0	0
Trenton, N. J.	—	41	36	77	1	0	1
Escambia River: Century, Fla.	[b] 0.9	12	4	16	0	0	0
Great Lakes:							
Buffalo, N. Y.	—	6	9	15	0	0	0
Detroit, Mich.	[b] 0.6	4	8	12	0	0	0
Port Huron, Mich.	0.4	2	5	7	0	0	0
Milwaukee, Wis.	—	8	12	20	0	0	0
Sault Ste. Marie, Mich.	—	4	6	10	0	0	0
Gary, Ind.	0.2	14	10	24	1	0	1
Duluth, Minn.	—	2	4	6	0	0	0
Hudson River: Poughkeepsie, N. Y.	0.2	4	9	13	0	0	0
Illinois River:							
Peoria, Ill.	0.4	31	37	68	2	2	4
Grafton, Ill.	—	179	55	234	5	1	6
Kanawha River: Winfield Dam, W. Va.	—	7	15	22	0	0	0
Klamath River: Copco, Oreg.	—	11	14	25	0	0	0
Little Miami River: Cincinnati, Ohio	[b] 1.1	52	57	109	<1	<1	1
Merrimack River: Lowell, Mass.	0.7	—	—	—	—	—	—
Mississippi River:							
St. Paul, Minn.	0.9	21	59	80	0	1	1
Dubuque, Iowa	—	31	36	67	—	—	—
Burlington, Iowa	0.6	44	38	82	0	6	6
E. St. Louis, Ill.	—	41	25	66	1	0	1
Cape Girardeau, Mo.	0.8	138	54	192	8	2	10
West Memphis, Ark.	—	59	31	90	1	1	2
Delta, La.	[b] 0.4	58	28	86	4	1	5
New Orleans, La.	—	17	21	38	1	1	2
Vicksburg, Miss.	—	88	36	124	2	2	4
Missouri River:							
Williston, N. Dak.	—	26	37	63	1	5	6
Bismarck, N. Dak.	—	20	24	44	1	1	2
Yankton, S. Dak.	0.6	—	—	—	—	—	—
Omaha, Nebr.	—	45	78	123	0	2	2
St. Joseph, Mo.	—	228	167	395	2	5	7
Kansas City, Kansas	—	96	70	166	2	3	5
St. Louis, Mo.	1.4	70	40	110	3	1	4
Monongahela River: Pittsburgh, Pa.	0.4	5	19	24	<1	<1	1
North Platte River: Henry, Nebr.	—	28	74	102	1	28	29
Ohio River:							
East Liverpool, Ohio	0.4	28	23	51	2	0	2
Huntington, W. Va.	—	22	13	35	0	0	0
Cincinnati, Ohio	—	9	20	29	0	1	1
Louisville, Ky.	0.4	2	18	20	<1	<1	1
Evansville, Ind.	—	12	22	34	0	0	0
Cairo, Ill.	1.1	—	—	—	—	—	—
Ouachita River: Bastrop, La.	—	37	49	86	1	1	2
Potomac River:							
Williamsport, Md.	—	21	32	53	0	0	0
Great Falls, Md.	—	13	29	42	1	1	2
Platte River: Plattsmouth, Nebr.	—	62	64	126	3	7	10
Rainy River: International Fls., Minn.	—	6	14	20	0	0	0
Red River, North: Grand Forks, N. Dak.	—	12	49	61	1	2	3
Red River, South:							
Denison, Tex.	—	10	13	23	0	3	3
Alexandria, La.	1.0	21	36	57	2	0	2
Rio Grande River:							
Alamosa, Colo.	[b] 0.4	2	13	15	0	1	1
Laredo, Tex.	—	44	27	71	2	3	5
Brownsville, Tex.	—	14	20	34	1	8	9

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	November 1961					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Roanoke River: John H. Kerr Reservoir & Dam, Va.	—	0	6	6	0	0	0
Sabine River: Ruliff, Tex.	—	17	24	41	<1	0	<1
San Juan River: Shiprock, N. Mex.	—	79	59	138	8	13	21
St. Lawrence River: Massena, N. Y.	—	5	16	21	0	0	0
Schuylkill River: Philadelphia, Pa.	—	0	3	3	—	—	—
Savannah River:							
Port Wentworth, Ga.	0.4	3	16	19	—	—	—
North Augusta, S. C.	—	3	4	7	0	0	0
Shenandoah River: Berryville, Va.	—	10	22	32	0	<1	<1
Snake River:							
Wawawai, Wash.	0.3	8	18	26	—	—	—
Payette, Idaho	—	13	24	37	0	4	4
South Platte River: Julesburg, Colo.	0.7	29	52	81	2	38	40
Susquehanna River:							
Sayre, Pa.	0.3	13	25	38	0	0	0
Conowingo, Md.	0.3	2	14	16	0	0	0
Tennessee River:							
Pickwick Landing, Tenn.	—	6	20	26	0	0	0
Chattanooga, Tenn.	0.6	3	14	17	0	0	0
Bridgeport, Ala.	0.7	4	18	22	0	0	0
Tombigbee River: Columbus, Miss.	—	30	20	50	<1	0	<1
Truckee River: Farad, Calif.	—	26	22	48	0	1	1
Yakima River: Richland, Wash.	0.4	3	10	13	0	2	2
Yellowstone River: Sidney, Mont.	—	24	29	53	1	6	7

[a] Dash denotes no samples received or no determinations made.
[b] April-September strontium-90 data.

Network has been composited into a three-month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating years of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Beginning September 1, 1961, gross beta determinations are to be made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Beginning October 1, 1961, gross alpha determinations are to be made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination will be made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all data reported for the period indicated. The reported strontium-90 data are the results of determinations on three-month composite samples for the quarter ending in the month shown.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

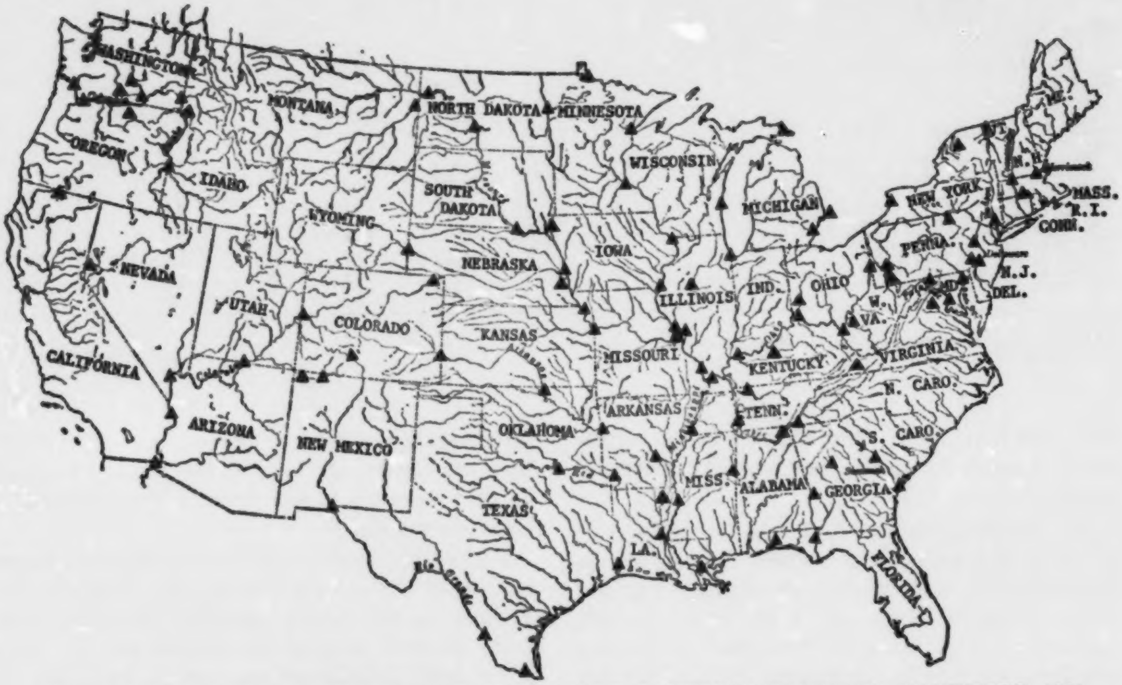
(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Water Works Association*, 51, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A. Gol[illegible], and P. F. Hallbach, "Strontium–90 in Surface Waters," *Journal of the American Water Works Association*, 52, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association*, 53, 704 (1961).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MONTANA
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MINNESOTA
OREGON
IDAHO
WISCONSIN
SOUTH DAKOTA
WYOMING
MICHIGAN
NEW YORK
MASS.
R.I.
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TENN.
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NEW MEXICO
OKLAHOMA
S. CARO.
MISS.
ALABAMA
GEORGIA
TEXAS
LA.
FLORIDA
VT.
N.H.
ME.

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, NOVEMBER 1961

Drinking Water Standards For Radioactivity

Division of Environmental Engineering and Food Protection
Public Health Service

Revision of the 1946 edition of the Public Health Service "Drinking Water Standards" became effective April 5, 1962. For the first time, these standards include permissible limits on radioactivity concentrations in municipal water supplies used by interstate carriers. Certification of these water supplies by the Surgeon General of the Public Health Service is required by law.

The Public Health Service "Drinking Water Standards" were first adopted in 1914 to protect the health of the traveling public. Since that time, the standards have become applicable to water supplies generally, and there has been a series of revisions. Technological advances, including the development of atomic energy, required that these Standards again be revised; an Advisory Committee was appointed to do so in 1959. This Advisory Committee consisted of representatives from Federal agencies, scientific associations, and industry. The American Water Works Association has endorsed the revised Standards and has recommended their use for all public water supplies.

The Drinking Water Standards which apply to radioactivity are concerned specifically with strontium-90, radium-226, and gross beta activity. Water supplies will be approved if they contain less than 3 μμc/liter of radium-226 and less than 10 μμc/liter of strontium-90. If either of these concentrations are exceeded, the water supply will not be approved by the certifying authority until the surveillance of total intakes of strontium-90 and radium-226 from all sources indicates that such intakes are within the limits recommended by the Federal Radiation Council for control action.

In the known absence of strontium-90 and alpha emitters (absence is taken to mean a negligibly small fraction of the specified limits with radium-226 used for alpha), the water supply is acceptable when gross beta concentrations do not exceed 1,000 μμc/liter. Gross beta concentrations in excess of 1,000 μμc/liter shall constitute grounds for rejection of the supply except when more complete analyses indicate that concentrations of nuclides are not likely to cause exposures greater than the Radiation Protection Guides recommended by the Federal Radiation Council.

Recommended radiochemical procedures may be found in "Manual of Methodology, Radionuclide Analyses of Environmental Samples," *Technical Report R59–6*, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio; and "Methods of Radiochemical Analysis," *Technical Report No. 173*, Report of the Joint WHO-FAO Committee, 1959, World Health Organization.

The 1962 Public Health Service Drinking Water Standards may be obtained from the Water Supply Activity, Interstate Carrier Branch, Public Health Service, Washington 25, D. C.

Drinking Water Analysis Program

Division of Environmental Engineering and Food Protection
Public Health Service

The Water Supply Activity of the Interstate Carrier Branch, Division of Environmental Engineering and Food Protection, PHS, has gathered extensive data on the radioactivity content of water supplies used on interstate carriers such as trains, airplanes, ships and other conveyances operating in interstate commerce. This work has several objectives, among which are:

1. to determine radioactivity content of interstate carrier water supplies for comparison with the revised Public Health Service Drinking Water Standards.
2. to establish the radioactivity background level as the base with which to compare future results from the supplies sampled.
3. to obtain data for study in connection with the occurrence of certain chronic diseases.

Beginning in November 1960, the project is a continuing one under which it is planned to cover ultimately the 850 U. S. water supplies used by interstate carriers. Figure 1 shows the nationwide distribution of the 140 municipalities included in the first sampling. In many instances, there are several sources for a

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municipality and each is sampled. Water supply sampling for a second group of cities is underway at the present time. When this is complete, another group of about 100 will be chosen.

Each sample is a composite of four aliquots a day obtained during a two week period. The analyses for gross alpha, gross beta, and strontium-90 are performed at the Southeastern and Southwestern Radiological Health Laboratories, operated by the Division of Radiological Health.

Table 1 presents partial data from the first sampling. The data will be published on a regular basis as it becomes available.

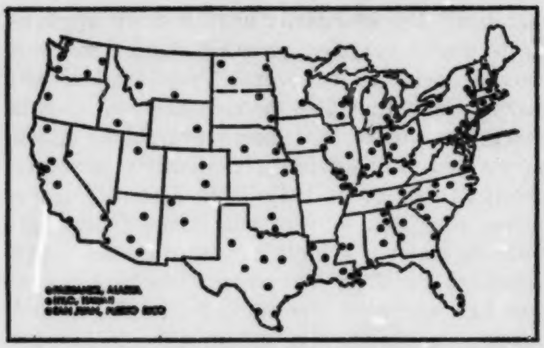

FIGURE 1.—DRINKING WATER ANALYSIS PROGRAM SAMPLING STATIONS

TABLE 1.—RADIOACTIVITY IN DRINKING WATERS

[Concentrations in $\mu\mu c$/liter]

Station	Population served	Date sampled	Strontium-90	Alpha activity			Beta activity		
			Total solids	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Sayre, Pennsylvania[a]	12,000	6/2-16/61	[b]—	0.5	0.5	1.0	3.0	3.0	6.0
Cairo, Illinois[a]	10,000	2/16-3/13/61	0.3	—	12.0	—	—	2.6	—
Chester, Illinois	5,400	2/15-3/2/61	0.6	—	0.5	—	—	3.6	—
Decatur, Illinois	78,000	7/11-26/61	—	—	—	—	3.0	3.0	6.0
Rock Island, Illinois	52,000	7/12-26/61	—	0.5	0.5	1.0	3.0	3.6	6.6
East St. Louis, Illinois[a]	250,000	2/14-28/61	0.9	—	0.5	—	—	3.3	—
Green Bay, Wisconsin	64,000	5/16-6/3/61	—	0.5	0.5	1.0	3.0	3.0	6.0
Madison, Wisconsin	135,000	7/18-8/1/61	—	—	—	—	3.0	3.8	6.8
Manitowoc, Wisconsin	31,600	5/17-31/61	—	0.5	0.5	1.0	3.0	3.0	6.0
Neenah, Wisconsin	18,100	5/18-6/3/61	—	0.5	0.5	1.0	3.0	2.9	5.9
Duluth, Minnesota[a]	108,000	7/21-8/11/61	—	0.5	0.5	1.0	1.0	2.0	3.0
Denver, Colorado	612,000								
Infiltration Gallery	—	2/15-3/2/61	—	—	—	0.9	—	—	2.7
Kassler Plant	—	2/15-3/1/61	—	—	—	0.7	—	—	3.1
N. Marston Lake Plant	—	2/15-3/2/61	—	—	—	<0.5	—	—	3.1
S. Marston Lake Plant	—	2/15-3/2/61	—	—	—	0.8	—	—	2.7
Moffat Plant	—	2/14-3/3/61	—	—	—	0.6	—	—	2.2
Pueblo, Colorado	110,000								
North Side Plant	—	5/25-6/9/61	—	—	—	<0.5	—	—	1.8
South Side Plant	—	5/25-6/9/61	—	—	—	<0.5	—	—	2.2
Twin Falls, Idaho	21,000								
City Treatment Plant	—	5/2-17/61	—	—	—	<0.5	—	—	3.6
Johnston Well	—	5/2-29/61	—	—	—	<0.5	—	—	2.9
Billings, Montana	65,500	1/17-31/61	—	—	—	1.5	—	—	3.2
Butte, Montana	50,000								
Basin Creek	—	1/19-2/5/61	—	—	—	0.7	—	—	2.4
Big Hole	—	1/19-2/3/61	—	—	—	1.1	—	—	2.2
Salt Lake City, Utah	275,000								
Big Cottonwood	—	3/21-4/22/61	—	—	—	<0.5	—	—	1.5
City Creek	—	3/22-4/5/61	—	—	—	<0.5	—	—	<0.5
3rd E. Pumping Station	—	3/21-4/5/61	—	—	—	1.1	—	—	2.9
15th E. Pumping Station	—	3/22-4/5/61	—	—	—	1.2	—	—	3.6
Little Cottonwood	—	3/23-4/10/61	—	—	—	<0.5	—	—	4.3
Casper, Wyoming	15,700	11/17-12/5/60	—	—	—	1.1	—	—	2.4

[a] Location also sampled by National Water Quality Network.

[b] Dashes indicate no determination reported (usually, strontium-90 is not determined unless gross beta exceeds 10$\mu\mu c$/liter).

SECTION IV.—OTHER DATA

Considerations in Establishing Radiation Protection Standards for Radioactivity in the Environment[1]

Donald R. Chadwick, M.D. and Conrad P. Straub, Ph.D.[2]

Introduction

In considering the technical aspects of the problems of establishing permissible levels of intake from environmental sources, it is appropriate to mention the organizational arrangements of the United States Government for the establishment of basic radiation protection standards. Recognition of the need for action by the Government came from an evaluation of the nature of the decisions involved in the establishment of basic radiation protection standards. At one time these standards were based upon the concept of tolerance dose, defined as a dose which when received by exposed individuals, would produce no deleterious biological effects. Under this concept, known as the threshold hypothesis, development of radiation protection standards was a scientific job involving the determination of the radiation dose below which effects would not occur.

In recent years, however, evidence has been accumulating which casts doubt on the assumption that it is possible to determine a safe dose—if by safe dose one means a dose which, even when used as a protection standard for a large population, will produce no harm in any individual. Evidence on the genetic effects of radiation indicates that even small doses of radiation delivered to the gonads prior to reproduction will be accompanied by an increase in genetic mutations, most of which are deleterious. With respect to the somatic effects, it is not clear whether small doses have a permanent injurious effect or not. In the establishment of radiation protection standards, therefore, it appears necessary to assume that any radiation dose is accompanied by an increased risk of deleterious biological effects, the magnitude of which increases with the dose. This hypothesis is generally referred to as the no-threshold hypothesis of dose-effect relationships.

Under the no-threshold hypothesis, the establishment of radiation protection standards requires acceptance of a certain risk of deleterious biological effects with any dose chosen as a standard. There must be a reason for accepting such a risk and this reason is sought in

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[1] Presented at Fourth Inter-American Symposium on the Peaceful Application of Nuclear Energy, Mexico City, Mexico, April 9–13, 1962.

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what has been termed "the benefits to be derived." Thus the benefits to be expected as a result of the radiation exposure must outweigh the potential risk or hazard. Or, looking at the situation from a slightly different vantage point, the reasons for accepting or permitting a particular level of exposure, rather than requiring the exposure to be reduced to a lower level, must outweigh the decrease in risk to be expected from the reduction in exposure.

Thus, the establishment of basic radiation protection standards is not strictly a scientific task. Scientific data are involved in the decision, but the decisions rest on achieving a balance between benefit and risk. The task involves the exercise of judgment, the nature of which has been expressed in the following language: "Fundamentally, setting basic radiation protection standards involves passing judgment on the extent of the possible health hazard society is willing to accept in order to realize the known benefits of radiation. It involves inevitably a balancing between total health protection which might require foregoing any activities increasing exposure to radiation and atomic energy in order to achieve optimum benefits."[1]

Decisions represented by basic radiation protection standards, therefore, are matters of public policy, and arrangements have been made within the United States Government for the establishment of this policy. The Federal Radiation Council was established in 1959 to advise the President with respect to radiation matters directly or indirectly affecting health, including guidance for all Federal agencies in the formulation of radiation standards. Members of the Council are the heads of the Federal agencies most significantly involved in radiation: Department of Health, Education, and Welfare, Atomic Energy Commission, Department of Defense, the Department of Commerce, and Department of Labor.

Terminology in the Application of Radiation Protection Standards

One of the problems in the application of radiation protection standards has been misunderstandings among members of the general public as to the nature of these standards. Radiation doses considered to represent an acceptable risk, under a given set of circumstances, have for many years been referred to as maximum permissible doses. Similarly, concentrations of various radioactive materials in air, water, or food, which are calculated to deliver the maximum permissible doses, have been referred to as maximum permissible concentrations. Although workers in the radiation protection field understand what is meant by the terms "maximum permissible," the Federal Radiation Council has felt that the expression may be misleading to the public. In particular, such terms tend to convey the impression that the doses are absolute limits below which exposed individuals are safe and above which dire consequences will ensue.

In an effort to forestall such misinterpretations, the Council uses the term "Radiation Protection Guide" in place of "Maximum Permissible Dose."[1] Consistent with the discussion of the basis for radiation protection standards, a radiation protection guide might be thought of as a radiation dose rate for indefinite exposure established for a given set of circumstances such that the benefits to be derived from applications conducted in a manner so as not to exceed that dose outweigh the potential hazard or risk. Recommended "Radiation Protection Guides" applicable to the radiation worker and the population are shown in Tables 1 and 2.

TABLE 1.—RADIATION PROTECTION GUIDES—RADIATION WORKER

Type of exposure	Condition	Dose (rem)
(a) Whole body, head and trunk, active blood-forming organs, gonads, or lens of eye.	Accumulated dose	5 times number of years beyond age 18.
	13 weeks	3.
(b) Skin of whole body	Year	30.
	13 weeks	10.
(c) Hands and forearms, feet and ankles.	Year	75.
	13 weeks	25.
(d) Bone	Body burden	0.1 microgram of radium-226 or its biological equivalent.
(e) Other organs	Year	15.
	13 weeks	5.

TABLE 2.—RADIATION PROTECTION GUIDES—POPULATION

Type of exposure	Condition	Dose, rem
(a) Individual	Year	0.5 (whole body).
(b) Average	30 years	5 (gonads).

60<

Factors Involved in the Establishment of Concentration Values for Foods, Air, and Water

Permissible levels, or concentration values (to use a term which may reduce misunderstandings) for individual items of food, air, or water are established to achieve the basic objective of the control of population exposure from radionuclides in the environment. These levels provide reasonable assurance that appropriate radiation doses or radiation protection guides are not exceeded. There are two basic methods by which this control is accomplished: restrictions on the entry of radioactive materials into the environment (source control) and measures taken in the environment after the materials have been released and spread designed to limit the intake of such materials by members of the general population (environmental control).

These two different methods of control involve fundamentally different considerations. In general, routine control is exercised through source control. Limits for source control are based on two considerations: (1) the benefits derived from useful applications of radiation and atomic energy justify the risk associated with the routine release of radioactivity to the environment, and (2) the routine release of radioactivity is limited to a value such that the additional reduction in hazard to be expected from lower limits would be too small to justify the additional impact of lower limits. This additional impact may be related to the problems associated with the kinds of measures which might be necessary to restrict release of materials from the source. Consistent, well-regulated, and effective source control usually will prevent the necessity from arising for consideration of environmental control. Examples of such source control are filtration and washing of gaseous wastes containing particulates, aerosols, and gaseous radioactive materials before release to the atmosphere and treatment, recovery, and containment of liquid and solid radioactive wastes.

Any environmental control involves significant difficulties in application. Therefore, the application of environmental controls demands consideration of the impact of these controls on the population and an assessment of this impact in relation to the risks of radiation exposure. For example, the ultimate environmental control, condemnation of water or food supplies, may involve very important health as well as social and economic considerations.

As stated above, the objective of the control of environmental radioactivity is to provide reasonable assurance that radiation protection guides are being met. The most direct means of evaluating the effectiveness of control measures is the determination of the amount of specific radioactive materials in the bodies of members of exposed population groups in order to compare these values with appropriate radiation protection guides for individuals. However, it is not always practical to monitor body burdens resulting from environmental contamination solely by the use of direct measurements on the human body, its tissues, or excreta. Furthermore, it is usually desirable to predict the significance of environmental contamination with radioactive materials without waiting until they accumulate in exposed individuals. One approach toward this end is exemplified by current infant retention studies in our laboratories. Body burdens are determined from differences in intake and excreta. These, or similar studies, provide the basis for predicting uptake of radioactive materials ingested at environmental levels and extrapolation to potential dose effects.

Routine control practice, therefore, generally involves calculation or determination of actual or potential concentrations of the various radioactive materials in air, water, and food, which correspond to appropriate radiation protection guides for suitable samples of exposed population groups. Control actions should be based on an evaluation of population exposure from all of these different environmental media with respect to appropriate radiation protection guides. The average total daily intake of the various radioactive materials from all sources by exposed population groups constitutes an appropriate criterion for this evaluation. Recent recommendations of the Federal Radiation Council, approved by the President, provide guidance in connection with transient rates of daily intake of radioactive material.[2] Rather than providing a single numerical guide for daily intake, the Council has given three ranges of transient rates of daily intake.

The Basis for the Graded Approach to Evaluation of Environmental Radioactivity

A continuous, or average daily intake can be calculated which is estimated to result, under specified conditions, in whole body or organ doses equal to a specified Radiation Protection Guide. Actual intakes of radioactive materials, however, could fluctuate very widely around this average value and still result in an annual dose which would not exceed the specified RPG. Here is one reason for the need for something other than a single numerical value as a basis for evaluation of daily intake.

As previously mentioned, control of intake involves two general methods: source control and environmental control. Within these categories are many different actions whose character and import vary widely from those which entail little interferences with usual activities, such as monitoring and surveillance, to those which involve a major disruption, such as condemnation of water or food supplies. Actions such as changes in water supplies or food production techniques may require prolonged lead times before becoming effective. For these and other reasons, the Federal Radiation Council decided that there was a need for a graded series of appropriate actions related to different ranges of intake of radioactive material by exposed population groups. In its second report, published in September 1961, the Council has developed such a graded approach.[3] The intake values corresponding to Ranges I, II, and III for iodine-131, radium-226, strontium-90, and strontium-89 are listed in Table 3. Table 4 summarizes the actions to be taken relative to each of these ranges of intake.

TABLE 3.—RADIATION PROTECTION STANDARDS—FEDERAL RADIATION COUNCIL

Nuclide	Critical organ	Intake levels, μμc/day		
		Range I	Range II	Range III
I^{131}	Thyroid	0-10	10-100	100-1,000
Ra^{226}	Bone	0-2	2-20	20-200
Sr^{90}	Bone and bone marrow	0-20	20-200	200-2,000
Sr^{89}	Bone and bone marrow	0-200	200-2,000	2,000-20,000

TABLE 4.—RADIATION PROTECTION STANDARDS—FEDERAL RADIATION COUNCIL

Range	Remarks
I	Calculations, based on source information. Surveillance adequate to confirm calculations.
II	Surveillance adequate to demonstrate levels. Control at source to avoid excess exposure as levels increase to top of Range II. Intakes do not exceed RPG values.
III	Surveillance to check effect of control actions. Control designed to reduce levels to Range II or lower. Intakes in Range III will result in exposures exceeding RPG if continued for a sufficient period of time.

Concentration Values in Food, Water, and Air

Many additional factors, some of which are subject to wide variation, must be considered in establishing concentration values for various sources of intake. While it is theoretically possible to calculate a single concentration value for ingestion to be the average concentration of a radioactive material present uniformly in all sources of ingestion which would conform to a given intake and its associated RPG, such a concentration value would not always be applicable in practice. Single concentration values may be relevant in source control where one is considering the controlled release of radioactive material in such a manner so as not to exceed appropriate RPG's. In environmental control, where the relative contribution of different sources of intake must be assessed, the single numerical value for concentration is limited in its application.

Radioactive materials may enter the body from any one or a combination of the three environmental media: air, water, and food. In any specific situation, before an appropriate concentration value can be developed for a specific medium, the relative contribution to total intake from the other media must be estimated. Although in some situations the problem may be simplified because most intake occurs from a single source, in many instances combinations of intake from water and food or air and food may occur. Data on the intake of calcium and strontium-90 from air, water, and food in Table 5 shows that food is the most important source of strontium-90.[4] In other instances, the contribution from water may be increased somewhat, particularly if cistern water supplies are used. Even when most intake is occurring in food, widely varying concentration values applying to different items

TABLE 5.—ENVIRONMENTAL SOURCES OF CALCIUM AND STRONTIUM-90 INTAKE IN CINCINNATI, 1958–59

Source	Estimated weekly intake	Calcium		Strontium-90	
		Weight	Per cent	Weight	Per cent
		gm./week		$\mu\mu c$/week	
Air	140 m^3			5.6	5.2
Water	7 liters	0.4	5.0	5.6	5.2
Food	(10.1 kg.)[a]	(7.6)	(95.0)	(96.5)	(89.6)
Milk	3.5 kg.	4.2	52.6	42.0	39.0
Other dairy products[b]	0.3 kg.	1.0	12.5	12.4	11.5
Vegetables	2.6 kg.	1.0	12.5	23.7	22.0
Meat, sea foods, and eggs	2.6 kg.	0.7	8.8	5.9	5.4
Cereals and pastries	0.9 kg.	0.4	5.0	9.5	8.8
Other	0.9 kg.	0.3	3.7	3.0	2.8
Totals					
Per week		8.0	100.0	107.7	100.0
Per day		1.1		15.4	

[a] Totals in parentheses.
[b] Exclusive of milk.

in the diet may be appropriate. Strontium-90 levels observed in selected items of the diet are listed in Table 6.[5] The point here might be clarified by an example. The following, taken from Federal Radiation Council's Staff Report No. 2,[2] are some of the considerations which may be involved in the determination of specific levels at which actions, such as the condemnation of certain food supplies, would take place:

1. Relative proportion of the total diet by weight represented by the item in question. It is quite apparent that a relatively high concentration of a radioactive material in an item such as pepper could produce a lower total daily intake than a much smaller concentration in an item such as milk. Referring again to Table 5, it is seen that meat, sea food, and eggs, which represent about one-fourth of the intake contribute only 1/16 of the strontium-90 to the diet, whereas milk, which represents about ⅓ of the dietary intake, accounts for 7/16 of the strontium-90 intake.
2. The importance of the particular item in nutrition and the availability of substitutes having the same nutritional properties, or perhaps stockpiles of uncontaminated foods. As previously emphasized, any consideration of possible condemnation of foods must involve an assessment of the health hazards which might result from the restriction of vital dietary elements. Many complex factors enter here. The area involved in the contamination, for example, may be very important. Different considerations would certainly be involved in the condemnation of, for in-

TABLE 6.—STRONTIUM-90 CONTENT OF VARIOUS FOOD ITEMS

Food	Year	Number of observations	Sr^{90}, $\mu\mu c$/kg (orig. weight)
Cabbage	1958	6	18 - 315
	1958–59	6	2.0- 14
	1959	20	1 - 48
	1960	12	1.1- 25
	1961	1	6.0
Lettuce	1958	3	5 - 21.1
	1958–59	5	5.4- 970
	1959	5	1.4- 60
	1960	17	1.1- 17
	1961	1	0.3
Tomatoes	1958	1	2.2
	1959	7	2 - 13
	1960	22	0.5- 9.9
Corn	1958	3	0 -1470
	1959	9	0.2- 6.0
	1960	1	0.31
Potatoes	1958	3	4.1- 12.3
	1958–59	6	0.5- 7.3
	1959	15	0.4- 8.2
	1960	7	0.4- 6
Apples	1958	3	2.7- 66
	1959	10	0.4- 6.9
	1960	10	0.2- 2.8
Barley	1958	2	105 - 314
	1959	2	25 - 53
	1959–60	1	54
	1960	1	59
Oats	1958–59	3	10 - 164
	1959	2	17 - 86
	1959–60	1	81
	1960	1	24
Rice	1958	1	2.1
Wheat	1958	32	22 - 140
	1958–59	11	4.8- 520
	1959	70	9 - 196
	1960	9	4 - 53
Wheat:			
Flour, white	1959	1	25.2
Flour, whole wheat	1959–60	2	48 - 56

TABLE 7.—CONCENTRATION OF RADIONUCLIDES AND POTASSIUM IN MILK AT TIME OF COLLECTION—OREGON STATE UNIVERSITY STUDY

Date—December 1961	Pasture cattle				Barn cattle			
	I^{131} μμc/l	Ba^{140} μμc/l	Cs^{137} μμc/l	K gm/l*	I^{131} μμc/l	Ba^{140} μμc/l	Cs^{137} μμc/l	K gm/l*
1	×	×	0	1.7	×	×	10	1.4
2	×	×	20	1.6	×	×	10	1.5
3	110	230	20	1.1	—	—	—	—
4	270	90	30	1.1	×	×	0	1.4
5	210	120	40	1.2	×	×	20	1.3
6	180	130	40	1.2	×	×	10	1.6
7	160	150	40	1.1	×	×	10	1.4
8	160	100	50	1.0	×	×	20	1.6
9	150	140	60	1.5	×	×	10	1.6
10	130	160	60	1.2	×	×	20	1.4
11	90	140	70	1.1	×	20	10	1.5
12	80	160	70	1.2	30	×	10	1.7
13	90	130	90	1.0	20	20	10	1.5
14	80	120	70	1.1	×	20	20	1.5
15	70	90	80	1.1	×	×	10	1.5
16	60	100	80	1.1	×	×	10	1.6
17	70	90	70	1.1	×	×	10	1.7
18	50	150	90	1.2	×	×	10	1.5

× Undetected.

* Based on 846 μμc/gm.

stance, a small portion of the total milk supply over a short space of time such as in the case of the Windscale Incident as opposed to very widespread contamination over a longer period of time.

3. Other possible control methods may be used. The simple expedient of keeping cattle in the barn during periods of fresh fallout and feeding them forage and other foods harvested earlier can have a marked effect on the levels of short-lived radionuclides found in milk. Data obtained during such a study (see Table 7) show that iodine-131, barium-140, and cesium-137 in fresh fallout were almost entirely absent in milk obtained from cattle remaining in the barn and fed previously harvested foodstuffs in contrast to milk obtained from pasture-fed cattle.[6] Another method of control might be the removal of the radioactive material from the particular dietary item without affecting its quality. Research is going on for example, as to the feasibility of the removal of strontium-90 from milk on a relatively large scale. Laboratory studies show that iodine-131 may also be removed.

4. The half-life of the radioactive material must be considered. In some instances, as in the case of the short-lived isotopes, a temporary holding period might be feasible. Here again, depending upon the length of time, availability of stockpiles of uncontaminated food as well as facilities for holding could be important.

5. Other internal or external sources of radiation exposure to the same organ must be evaluated.

6. Relative contribution of other dietary items to the total daily intake of the nuclide must be noted.

7. Physical, chemical, and other factors have an effect on the relationship between intake and uptake of the nuclide. The use of stable iodine has been considered as an addition to the diet to reduce uptake of radio-iodine. Attention must be directed not only to the effectiveness and feasibility of such a measure but also to its possible hazards.

8. Consideration must be given to the time and effort required to effect corrective action.

Conclusion

From the preceding discussion it is evident that in this field it is far easier to raise questions than it is to answer them. The deeper one goes into the problems of establishing permissible levels in environmental media and of applying them in normal and emergency situations, the more difficult it is to emerge with clear, direct, and generally applicable standards. Particularly in the case of emergency situations, it would appear that it is virtually impossible to pre-judge these situations. General guidelines, of course, must be provided. However, there appears to be no substitute for the careful evaluation of all relevant facts about the situation by competent, responsible, authorities at the time.

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External Gamma Activity

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable geiger-mueller survey instruments are used to obtain measurements at three feet above the ground surface. February 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, FEBRUARY 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Lansing	Mich	0.02
Anchorage	Alaska	0.01	Minneapolis	Minn	0.01
Attu	Alaska	0.01	Jackson	Miss	0.01
Cold Bay	Alaska	0.01	Pascagoula	Miss	—
Fairbanks	Alaska	0.01	Jefferson City	Mo	0.01
Juneau	Alaska	0.02	Helena	Mont	0.03
Kodiak	Alaska	0.02	Lincoln	Nebr	—
Nome	Alaska	[a]—	Trenton	N. J	0.02
Point Barrow	Alaska	0.01	Santa Fe	N. Mex	0.03
St. Paul Island	Alaska	—	Albany	N. Y	0.03
Phoenix	Ariz	0.02	New York	N. Y	—
Little Rock	Ark	0.01	Gastonia	N. C	0.02
Berkeley	Calif	0.01	Bismarck	N. Dak	0.01
Los Angeles	Calif	—	Columbus	Ohio	0.01
Denver	Colo	0.02	Oklahoma City	Okla	0.02
Hartford	Conn	0.01	Ponca City	Okla	0.04
Washington	D. C	0.02	Portland	Oreg	0.02
Jacksonville	Fla	0.01	Harrisburg	Pa	0.01
Miami	Fla	0.01	San Juan	P. R	—
Atlanta	Ga	0.02	Providence	R. I	0.02
Agana	Guam	0.03	Columbia	S. C	0.02
Honolulu	Hawaii	0.02	Pierre	S. Dak	0.02
Boise	Idaho	0.02	Nashville	Tenn	0.01
Springfield	Ill	0.01	Austin	Tex	0.01
Indianapolis	Ind	0.01	El Paso	Tex	0.02
Iowa City	Iowa	0.01	Salt Lake City	Utah	0.02
Topeka	Kans	0.02	Richmond	Va	0.01
Frankfort	Ky	0.01	Seattle	Wash	0.02
New Orleans	La	0.02	Madison	Wis	0.02
Augusta	Maine	0.02	Cheyenne	Wyo	0.02
Baltimore	Md	0.02	Sundance	Wyo	—
Lawrence	Mass	0.02			

[a] Dash indicates no data received.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U. S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *RHD* since November 1960. Summaries follow for Argonne National Laboratory and Rocky Flats Plant, covering the third and fourth quarters of 1961.

The measured concentration of a radioactive substance in air and water may be compared with the Maximum Permissible Concentration (MPC) of that substance as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards "Handbook 69".

For purposes of clarity and perspective, a few of the applicable environmental MPC values are listed in table 1. Such values are intended as guides only. For further clarification, "Handbook 69" should be consulted.

The establishment of MPC's does not imply that each nuclide may be permitted to be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

TABLE 1.—SELECTED ENVIRONMENTAL MPC VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{223}, Ra^{226}, Ra^{228}, Pa^{231}, and Th-nat are not present[1]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present [1]	600	—
3	If Ra^{226}, Ra^{228} are not present [1]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present [1]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present [1]	—	10
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present [1]	—	100
8	Barium–lanthanum-140	20,000	4,000
9	Cerium-141	90,000	5,000
10	Cerium-144	10,000	300
11	Cesium-137	20,000	500
12	Cobalt-58	90,000	2,000
13	Cobalt-60	50,000	300
14	Iodine-131	2,000	300
15	Plutonium-239	5,000	0.06
16	Ruthenium–rhodium-106	10,000	200
17	Strontium-89	10,000	1,000
18	Strontium-90	100	10
19	Uranium, natural	20,000	2
20	Zirconium–niobium-95	60,000	1,000

---

[1] "Not present" implies the concentration of the nuclide is small compared with its appropriate MPC. According to recent AEC Regulations (*Federal Register*, Title 10, Part 20, pages 7142–7143, August 9, 1961) a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

In the following reports, the use of nonspecific terms as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References to table 1 will be made to designate the appropriate MPC's reported by the laboratory.

Argonne National Laboratory

University of Chicago, Lemont, Illinois
Third and fourth quarters 1961

Air Monitoring

Weekly continuous air filter samples were collected at seven locations on the Argonne National Laboratory (ANL) site as shown in figure 1 and at four off site locations at Aurora (west of ANL site), Hinsdale (northeast), Joliet (southwest), and Tinley Park (southwest). The monthly averages of alpha, beta, and several nuclide concentrations are given in table 2. The data show little differences between off-site and on-site measurements for alpha activity and most of the nuclides, inferring than ANL does not contribute detectable quantities of these activities to the atmosphere.

Analysis by gamma measurements of the long-lived fission products cerium-144, ruthenium-rhodium-106, and cesium-137, was not practical in the presence of the much higher concentrations of shorter lived fission products from the 1961 U.S.S.R. nuclear tests. Therefore, beginning with September, the shorter lived fission products cerium-141, zirconium-niobium-95, and barium-lanthanum-140 were monitored by the same method. Iodine-131 was detected but not quantitatively determined.

Water Monitoring

ANL waste water is discharged into Sawmill Creek, a stream that runs through the Argonne grounds and enters the Des Plaines River about 500 yards downstream from the waste water discharge. Sampling locations on Sawmill Creek and Des Plaines River are shown in figures 1 and 2 respectively.

On Sawmill Creek, weekly grab samples are collected upstream and three times a week downstream from the waste water outfall. The upstream flow is roughly equal to the waste water flow, yielding a dilution factor of one-half. The data in table 3 show significantly higher concentrations downstream than upstream, an indication of the radioactivity contributed to the stream by ANL. A comparison of the downstream concentrations with the environmental MPC's listed in table 1 shows that all concentrations are relatively low. The highest percent of MPC is that for Sr^{90} for the third quarter, 1.7%.

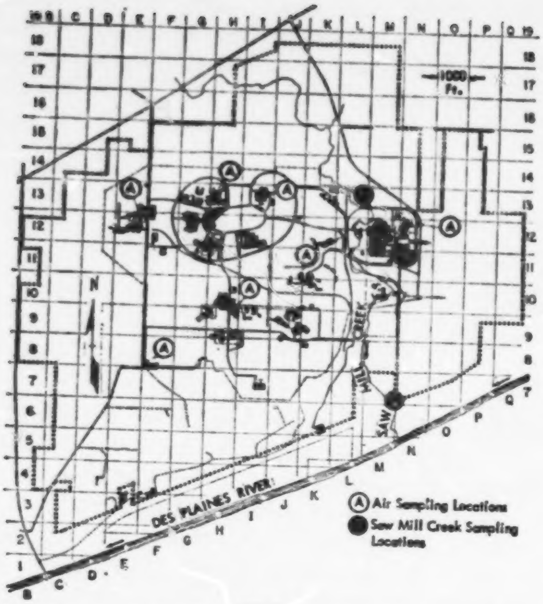
Weekly grab samples are collected from the Des Plaines River upstream and downstream from its junction with Sawmill Creek. The data in table 4 indicate that the dilution factor of the Des Plaines River is so large that the radioactivity contribution from ANL was not detected.

Grass Analysis for Iodine-131

Samples of grass were collected during August, as a followup of the program initiated in March 1961, to check the environmental deposition of idoine-131 that was released during February and March (see *RHD* December 1961). Grass has been demonstrated to be a very sensitive indicator for iodine-131. The August samples, collected near the points of release, had concentrations of iodine-131 less than the minimum level of detection, 1 $\mu\mu$c/gm.

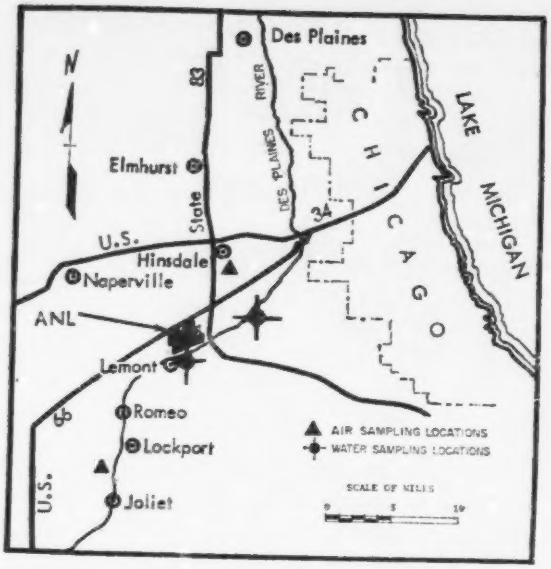
Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	December 1960
Second quarter 1960	April 1961
Third and fourth quarters 1960	July 1961
First and second quarters 1961	December 1961



1000 Ft.
N
DES PLAINES RIVER
SAW MILL CREEK
Ⓐ Air Sampling Locations
● Saw Mill Creek Sampling Locations

FIGURE 1.—ON-SITE SAMPLING LOCATIONS, ARGONNE NATIONAL LABORATORY



Des Plaines
N
LAKE MICHIGAN
CHICAGO
Elmhurst
State 83
DES PLAINES RIVER
U.S. 34
Hinsdale
Naperville
ANL
Lemont
Romeo
Lockport
Joliet
U.S. 66
▲ AIR SAMPLING LOCATIONS
✦ WATER SAMPLING LOCATIONS
SCALE OF MILES
0
5
10

FIGURE 2.—SITE LOCATION OF ARGONNE NATIONAL LABORATORY (INCLUDING SOME OFF-SITE SAMPLING STATIONS)

TABLE 2.—ACTIVITIES IN AIR FILTER SAMPLES, ANL, 1961

[Average concentrations in $\mu\mu c/m^3$]

Type of activity	Relative sampling location	July	August	September	October	November	December
Alpha	On-site	0.0042	0.0046	0.0045	0.0036	0.0037	0.0041
	Off-site	0.0050	0.0027	0.0048	0.0033	0.5032	0.0041
Beta	On-site	0.099	0.068	12.3	7.4	7.2	5.1
	Off-site	0.112	0.064	10.6	6.6	7.3	4.4
Ce^{144}	On-site	0.011	0.007	[a] —	—	—	—
	Off-site	0.014	0.006	—	—	—	—
$Ru\text{-}Rb^{106}$	On-site	0.053	0.048	—	—	—	—
	Off-site	0.070	0.043	—	—	—	—
Cs^{137}	On-site	0.009	0.006	—	—	—	—
	Off-site	0.012	0.005	—	—	—	—
Ce^{141}	On-site	—	—	0.53	0.85	0.69	0.54
	Off-site	—	—	0.33	0.74	0.77	0.76
$Zr\text{-}Nb^{95}$	On-site	—	—	0.91	1.1	1.3	1.5
	Off-site	—	—	0.82	1.1	1.4	1.7
$Ba\text{-}La^{140}$	On-site	—	—	7.5	3.2	1.9	0.58
	Off-site	—	—	6.4	2.7	1.7	0.67

[a] Dash denotes no analysis made.

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TABLE 3.—ACTIVITIES IN SAWMILL CREEK UPSTREAM AND DOWNSTREAM WATER OUTFALL, ANL, 1961

[Average concentrations in μμc/liter]

Type of activity	Sampling location	Third quarter	Fourth quarter	Calendar year
Total alpha	Upstream	1.5	1.9	1.9
	Downstream	6.2	4.4	6.8
Total beta	Upstream	7.7	20.7	10.5
	Downstream	36.5	40.4	30.4
U-Nat	Upstream	1.3	1.0	1.2
	Downstream	5.7	3.3	5.6
Pu^{239}	Upstream	<0.05	<0.05	<0.05
	Downstream	0.14	0.05	0.08
$Th\text{-}Pa^{234}$	Upstream	1.0	1.0	1.0
	Downstream	4.9	2.6	4.7
Sr^{90}	Upstream	1.1	0.6	0.6
	Downstream	1.7	0.6	1.3
Cs^{137}	Upstream	0.6	0.8	0.5
	Downstream	2.3	2.0	2.2
I^{131}	Upstream	[a]	2.8	<1.0
	Downstream	—	2.1	3.3
Co^{60}	Upstream	<1.0	<1.0	<1.0
	Downstream	1.0	1.6	1.2
Co^{58}	Upstream	<5	<5	<5
	Downstream	118	59	86

[a] Dash indicated not reported.

TABLE 4.—ACTIVITIES IN THE DES PLAINES RIVER UPSTREAM AND DOWNSTREAM FROM SAWMILL CREEK, ANL, 1961

[Average concentrations in μμc/liter]

Type of activity	Sampling location	Third quarter	Fourth quarter	Calendar year
Total alpha	Upstream	2.2	3.6	2.6
	Downstream	2.0	3.2	2.4
Total beta	Upstream	12.8	37.7	17.2
	Downstream	12.5	36.5	16.9
U-Nat	Upstream	1.3	1.8	1.6
	Downstream	1.6	1.7	1.6
Sr^{90}	Upstream	0.9	0.7	0.6
	Downstream	1.1	0.6	0.6

Rocky Flats Plant

Dow Chemical Company, Denver, Colorado
Third and Fourth Quarters 1961

The Rocky Flats Plant (RFP) is engaged in plutonium fuel element fabrication under contract to the Atomic Energy Commission. To assure properly controlled release of radioactive materials to the environment, water, air, and vegetation, are sampled periodically and analysed for gross alpha activity. On occasions when analyses were made, most of the activity was shown to be uranium. The most active material involved in the process is plutonium.

Because the plant is located on gravel washed out of the highly mineralized Front Range of the Rocky Mountains, heterogeneous low-level deposits of uranium, thorium and radium exist in the soil of the area and are measurable in most samples of air, water and vegetation as well. In fact, the activities of these elements and their radioactive decay products are the only radioactivity detected except following periods of testing of atomic devices.

Air Monitoring

During the third and fourth quarters, 24-hour air samples were collected at Coal Creek Canyon, Marshall, Boulder, Lafayette, Bromfield, Wagner School, Golden, Denver and Westminster. The results are tabulated in table 5. The activity is believed to consist entirely of that from air-borne uranium minerals.

Water Monitoring

Water samples were collected routinely from four reservoirs at distances ranging from 3 to 8 miles from RFP. Non-routine raw surface water samples were collected from a number of streams and lakes up to 15 miles distant.

The alpha concentrations in the 40 reservoir samples, collected during the third and fourth quarters, varied from < 0.4 to 2.5 μμc/liter.

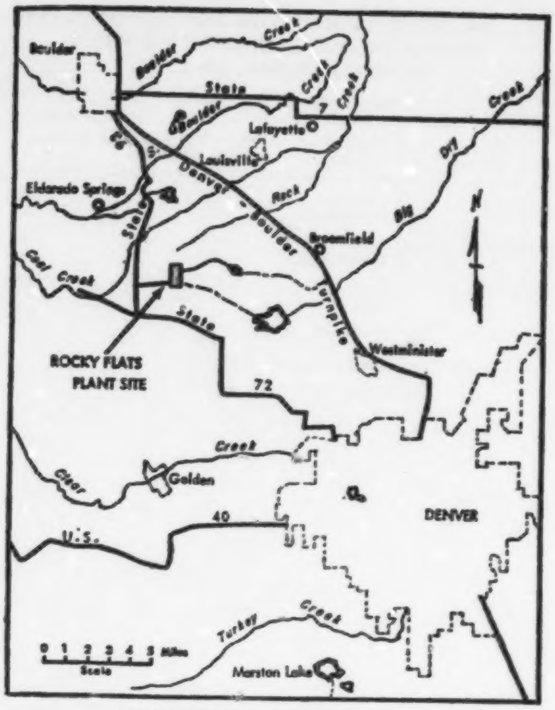
Boulder
Boulder
Creek
State
Creek
Creek
Boulder
Lafayette
Louisville
Eldorado Springs
Denver
Rock
Dry
Creek
Broomfield
Big
Boulder
Turnpike
State
Coal Creek
State
Westminster
ROCKY FLATS
PLANT SITE
72
Creek
Clear
Golden
DENVER
40
U.S.
Turkey
Creek
0 1 2 3 4 5 Miles
Scale
Marston Lake
N

FIGURE 3.—LOCATION OF THE ROCKY FLATS PLANT ENVIRONMENT, DENVER, COLORADO

All but one of the 39 raw surface water samples had alpha concentrations below 4 μμc/liter. One sample with a concentration of 15.2 μμc/liter was analysed. All the activity was natural uranium.

TABLE 5.—LONG-LIVED ALPHA ACTIVITY IN PARTICULATES IN AIR, RFP

Month	Average alpha concentration (μμc/m³)
July	<0.020
August	<0.015
September	<0.033
October	<0.018
November	<0.011
December	<0.012

Vegetation Samples

A total of 93 vegetation samples collected during May and June 1961 were analyzed during the third and four quarters. The average alpha activity was 48 μμc/kg dry weight with a standard deviation of 30 μμc/kg.

Previous coverage in *Radiological Health Data*

Period	*Issue*
Third quarter 1960 through second quarter 1961	November 1961

Nevada Test Site

Atomic Energy Commission
March 1962

Following a subsurface nuclear detonation on March 5, 1962, at the Nevada Test Site, small amounts of radioactivity were detected off-site. The highest gamma radiation level measured at a populated area off-site was at Warm Springs, Nevada (about 70 miles from the Site), where two or three persons were present. The total radiation exposure estimated at this location was less than one milliroentgen.

Some spot readings at Clarke Station (about 65 miles from the Site, where two persons were present) showed somewhat higher values than at Warm Springs, and the total exposure might have been somewhat higher. Both of these radiation doses were too low to be recorded on a standard film badge.

The gross beta activity in the air at Warm Springs is given in the table below.

TABLE 6.—GROSS BETA DETERMINATIONS OF SURFACE AIR, NTS, MARCH 1962

(Concentrations in μμc/m³)

Time and date of collection	Time and date of counting	Activity at time of counting
0900–1010, March 5	2217, March 5	56.3*
	0842, March 6	32.3
1020–1515, March 5	2100, March 5	650
	0830, March 6	287
	1625, March 7	87
	0904, March 8	76
	1304, March 15	24
1520–0600, March 5–6	0955, March 7	15.2
	1327, March 15	12.3

* Current radioactivity levels in this area fluctuate at around 10 μμc/m³.

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Reported Nuclear Detonations

Previous issues of *Radiological Health Data* since October 1961 have published available information on the dates, sizes, and types of nuclear tests conducted at various locations by the United States and the Union of Soviet Socialist Republics. The April 1962 *RHD* contains summary data through March 31, 1962. The following table reports on subsequent tests through April 30, 1962. Low yield range has been announced as meaning about a nominal (20-kiloton) yield, low-intermediate to mean a nominal and one megaton yield.

REPORTED U.S. DETONATIONS, APRIL 1962

Test number	Location	Date	Size	Type of test
27	Nevada Test Site	April 5	Low yield	Underground
28	Nevada Test Site	April 6	Low yield	Underground
29	Nevada Test Site	April 12	Low yield	Underground
30	Nevada Test Site	April 14	Low yield	Underground
31	Nevada Test Site	April 21	Low yield	Underground
32	Christmas Island, Pacific	April 25	Intermediate yield	Atmospheric
33	Christmas Island, Pacific	April 27	Intermediate yield	Atmospheric
34	Nevada Test Site	April 27	Low yield	Underground

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT JUNE 1962

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service • Division of Radiological Health

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ADVANCE REPORT

The AEC and Weather Bureau-predicted spring rise in fallout levels of strontium–89, strontium–90, and cesium–137 appears evident from preliminary data reported by the Public Health Service milk monitoring program. Comparisons of April network averages with those of the first quarter 1962 show increases (significant at the 90 percent confidence level) as shown in the table below. These increases are attributable to the expected spring rise rather than recent United States testing in the atmosphere.

Radionuclide	Network averages (μμc liter)	
	First quarter 1962	April 1962
Strontium–89	30	63
Strontium–90	8.7	12.0
Cesium–137	11	25

The May network average monthly tabulations for 61 stations in the milk sampling network shows 20 μμc/liter of iodine–131 in milk. During March and April the average value for milk was less than 10 μμc/liter. Relatively high levels were detected in several States located generally in the mid-west. Average levels of more than 20 μμc/liter were noted at 10 sampling stations. Values greater than 100 μμc/liter were determined at three stations. The monthly average for the station with the highest reported concentrations was 220 μμc/liter.

Air levels of gross beta radioactivity as determined by the Radiation Surveillance Network and the National Air Sampling Network have remained essentially the same as those measured previous to the reported increases in pasteurized milk iodine–131 levels. Gamma spectrometry on early May air samples, with gross beta measurements about 10 μμc/m^3, has shown iodine–131 to be less than one μμc/m^3 of air.

Editor's Note: The above information is preliminary and subject to further confirmation. It summarizes recent data submitted to the Radiation Surveillance Center, Division of Radiological Health, Public Health Service.

UNITS AND EQUIVALENTS

For the convenience of the reader, a selected list of units and equivalents frequently used in *Radiological Health Data (RHD)* are presented below.

Symbol	Name of unit	Equivalents
cpm	count per minute.	
dpm	disintegration per minute.	
μμc	micromicrocurie	1 μμc = 2.22 dpm.
mc/km^2	millicurie per square kilometer	1 mc/km^2 = 1000 μμc/m^2 = 2.59 mc/mi^2.
mi^2	square mile.	
m^2	square meter.	
m^3	cubic meter	1 m^3 = 1000 liters.
gm	gram.	
kg	kilogram	1 kg = 1000 gm.
mm	millimeter	precipitation: mm = $\frac{\mu\mu c/m^2}{\mu\mu c/liter}$
mr/hr	milliroentgen per hour.	

SECTION I.—AIR

Radiation Surveillance Network

Division of Radiological Health, Public Health Service

The Public Health Service Radiation Surveillance Network (RSN) was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in levels of radioactivity in air and precipitation due to fallout from nuclear weapons tests. Prior to September 1961, the Network consisted of 45 stations. Following the September 1961 resumption of nuclear weapons testing by the U.S.S.R., the Network was expanded over a period of a few months to 66 stations (see figure 1).

Air

Measurements of gross beta activity of particulates in surface air are taken because they provide one of the earliest and most sensitive indications of increases of activity in the environment and thus act as an "alert" system. A direct evaluation of biological effects is not possible from these data alone.

Daily 24-hour air samples are collected by a high volume air sampler with a carbon-loaded cellulose dust filter. Field measurements with a portable survey meter enable the station operator to estimate the amount of beta activity of particulates in air at the station five hours after collection by comparison with a known radioactive source. Each operator then reports his field estimates by telephone to the DRH Radiation Surveillance Center in Washington, D.C., to provide a daily national "alert" report. The filters are then forwarded to the central laboratory of the Radiation Surveillance Network for a more refined measurement using a thin-window gas flow proportional counter. The average fission product beta concentrations in surface air during March 1962 appear in table 1. The data shown represent the activities extrapolated to the time of collection.

Precipitation

Continuous sampling for total precipitation is conducted at each station on a daily basis using locally-made funnels having collection areas of 0.4 square meter (m^2). One-half liter of the collected precipitation is evaporated to dryness, and the residue is forwarded to the laboratory to be counted by the same method used for analyzing the air samples. The monthly averages of gross beta activity in precipitation, expressed in micromicrocuries per liter ($\mu\mu c$/liter) and micromicrocuries per square meter ($\mu\mu c/m^2$), are presented in table 2 for March 1962.

When the gross beta concentration of a given daily precipitation sample is too low for reliable measurement, an activity ($\mu\mu c/m^2$) calculated from the minimum level of detection is included in the monthly summation of activity. In the event that the sum of such "less-than"

TABLE 1.—GROSS BETA ACTIVITY OF PARTICULATES IN AIR, RSN, MARCH 1962

Station location		Number samples	Maximum	Minimum	Average[1]
City	State				
Adak	Alaska	22	5.9	0.50	2.4
Anchorage	Alaska	24	8.0	0.78	5.7
Attu	Alaska	24	9.1	0.79	3.4
Cold Bay	Alaska	24	8.9	0.38	3.0
Fairbanks	Alaska	23	6.1	1.0	4.2
Juneau	Alaska	20	8.2	<0.10	3.6
Kodiak	Alaska	24	7.9	0.27	4.7
Nome	Alaska	1	2.6	2.6	2.6
Point Barrow	Alaska	7	2.2	1.0	1.5
St. Paul Island	Alaska	19	3.9	0.76	2.5
Phoenix	Ariz	24	15	4.1	9.2
Little Rock	Ark	24	9.3	2.4	5.8
Berkeley	Calif	24	22	0.86	5.0
Los Angeles	Calif	23	16	2.5	7.4
Denver	Colo	22	10	3.4	7.2
Hartford	Conn	24	7.8	0.63	4.0
Washington	D. C	30	9.8	1.1	4.8
Jacksonville	Fla	24	16	2.5	9.3
Miami	Fla	24	11	2.3	6.9
Atlanta	Ga	24	12	1.3	5.3
Agana	Guam	18	7.2	1.4	3.4
Honolulu	Hawaii	23	5.6	0.61	3.3
Boise	Idaho	23	14	2.6	6.9
Springfield	Ill	24	9.6	1.7	4.9
Indianapolis	Ind	24	12	1.5	5.6
Iowa City	Iowa	23	9.3	0.71	4.8
Topeka	Kans	24	9.4	3.1	6.0
Frankfort	Ky	25	11	2.4	7.4
New Orleans	La	24	11	1.6	6.6
Augusta	Maine	29	8.2	0.28	4.0
Presque Isle	Maine	10	5.7	0.44	2.7
Baltimore	Md	23	10	1.1	5.4
Lawrence	Mass	23	5.7	0.91	3.7
Winchester	Mass	3	6.4	1.0	3.0
Lansing	Mich	31	18	2.3	7.9
Minneapolis	Minn	24	9.8	1.9	4.8
Jackson	Miss	24	9.8	2.0	6.0
Pascagoula	Miss	22	15	2.0	8.9
Jefferson City	Mo	24	9.1	2.0	5.1
Helena	Mont	24	11	2.3	5.5
Lincoln	Nebr	15	8.4	2.7	5.0
Trenton	N. J	22	6.6	0.66	3.9
Santa Fe	N. Mex	23	21	4.7	9.9
Albany	N. Y	24	9.5	0.25	5.2
Buffalo	N. Y	3	10	4.1	8.0
New York	N. Y	9	11	2.7	7.3
Gastonia	N. C	24	13	0.76	7.3
Bismarck	N. D	23	8.2	1.6	4.1
Columbus	Ohio	21	12	2.3	7.4
Oklahoma City	Okla	24	12	4.4	8.2
Ponca City	Okla	24	5.7	1.9	3.2
Portland	Oreg	22	12	0.71	5.3
Harrisburg	Pa	23	25	1.2	6.1
San Juan	P. R	9	12	1.9	7.1
Providence	R. I	24	8.2	0.45	4.[illegible]
Columbia	S. C	24	8.6	0.81	5.2
Pierre	S. D	30	7.1	1.4	4.2
Nashville	Tenn	23	13	2.2	6.7
Austin	Tex	23	10	2.8	7.7
El Paso	Tex	23	15	2.7	9.2
Salt Lake City	Utah	24	13	2.6	6.6
Richmond	Va	24	7.7	1.5	4.4
Seattle	Wash	24	6.5	0.60	2.7
Madison	Wis	24	10	3.2	6.1
Cheyenne	Wyo	24	12	2.4	6.3
Sundance	Wyo	11	11	3.0	5.6
Network average					5.47

[1] Weighted average obtained by summing the products of individual sampling times and the corresponding activities, and dividing by the summation of the individual sampling times.

TABLE 2.—GROSS BETA ACTIVITY IN PRECIPITATION, RSN, MARCH 1962

Station location		Average concentration (μμc/liter)	Total activity (μμc/m²)
City	State		
Adak	Alaska	[a]—	—
Anchorage	Alaska	880	3,400
Attu	Alaska	—	—
Cold Bay	Alaska	—	—
Fairbanks	Alaska	1,100	12,000
Juneau	Alaska	900	280,000
Kodiak	Alaska	—	—
Nome	Alaska	—	—
Point Barrow	Alaska	—	—
St. Paul Island	Alaska	—	—
Phoenix	Ariz	—	—
Little Rock	Ark	2,600	330,000
Berkeley	Calif	1,100	95,000
Los Angeles	Calif	2,000	56,000
Denver	Colo	1,200	1,300
Hartford	Conn	1,300	42,000
Washington	D. C	1,000	91,000
Jacksonville	Fla	1,100	99,000
Atlanta	Ga	1,700	180,000
Agana	Guam	—	—
Honolulu	Hawaii	1,100	60,000
Boise	Idaho	800	24,000
Springfield	Ill	—	—
Indianapolis	Ind	2,200	150,000
Iowa City	Iowa	3,200	190,000
Topeka	Kans	2,000	75,000
Frankfort	Ky	1,700	90,000
New Orleans	La	2,500	78,000
Augusta	Maine	2,300	100,000
Presque Isle	Maine	—	—
Baltimore	Md	—	—
Lawrence	Mass	1,700	50,000
Winchester	Mass	—	—
Lansing	Mich	1,700	31,000
Minneapolis	Minn	980	29,000
Jackson	Miss	2,200	42,000
Pascagoula	Miss	—	—
Jefferson City	Mo	1,700	150,000
Helena	Mont	3,300	28,000
Lincoln	Nebr	4,400	140,000
Trenton	N. J	300	5,000
Santa Fe	N. Mex	3,200	55,000
Albany	N. Y	1,000	21,000
Buffalo	N. Y	—	—
New York	N. Y	—	—
Gastonia	N. C	1,300	150,000
Bismarck	N. D	1,800	11,000
Columbus	Ohio	2,100	89,000
Oklahoma City	Okla	—	—
Ponca City	Okla	1,400	32,000
Portland	Oreg	930	36,000
Harrisburg	Pa	1,800	9,000
San Juan	P. R	—	—
Providence	R. I	1,600	55,000
Columbia	S. C	1,900	210,000
Pierre	S. D	370	3,200
Nashville	Tenn	1,900	83,000
Austin	Tex	2,300	70,000
El Paso	Tex	2,200	5,000
Salt Lake City	Utah	2,900	180,000
Richmond	Va	1,100	100,000
Seattle	Wash	4,400	230,000
Madison	Wis	1,900	60,000
Cheyenne	Wyo	2,900	12,000
Sundance	Wyo	—	—

[a] Dash denotes no evaporated sample received.

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activities is greater than one-tenth of the total gross beta activity for the month, the monthly activity is reported with a less-than (<) sign.

Review: Geographical Distribution of Fission Product Beta Concentrations in Air, September 1961 through February 1962

Beginning with this issue, monthly average fission product concentrations in air (based on laboratory measurements) will be indicated on the sampling station map (figure 1) by means of iso-concentration lines. For comparison, similar maps for the months August 1961 through February 1962 are presented in figure 2. [*Editor's Note: External gamma data submitted by RSN is reported in section 5.*]

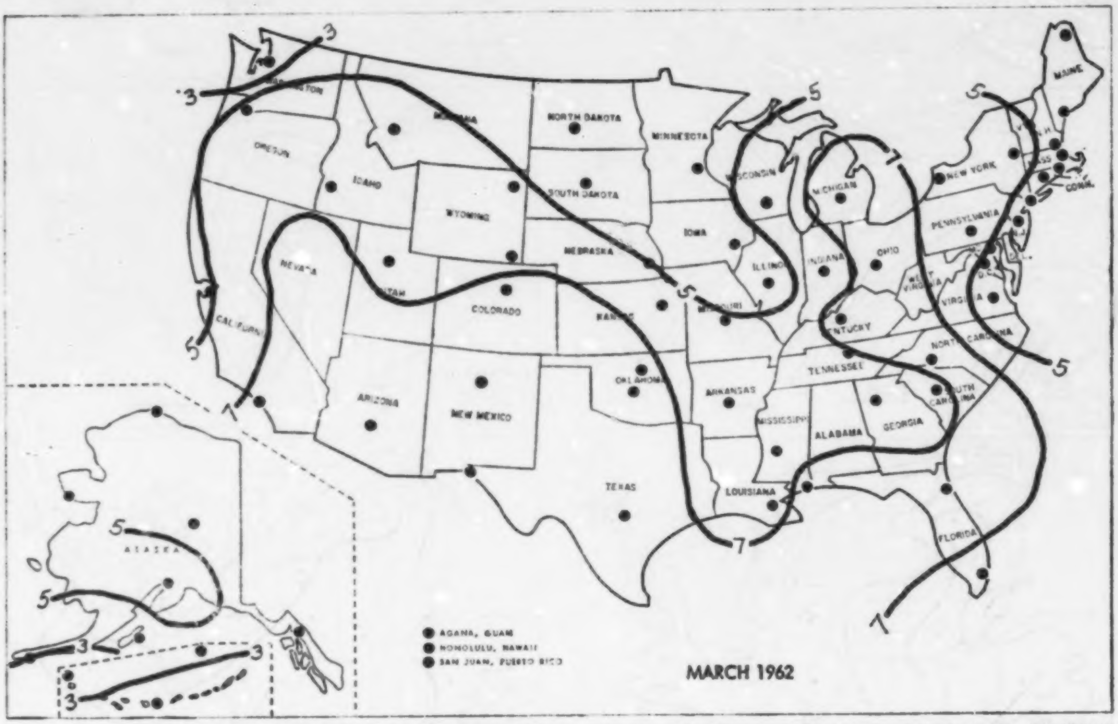
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
CONN.
ALASKA
3
3
5
7
5
7
5
5
7
7
5
3
3
3
5
5
AGANA, GUAM
HONOLULU, HAWAII
SAN JUAN, PUERTO RICO
MARCH 1962

FIGURE 1.—RADIATION SURVEILLANCE NETWORK SAMPLING STATIONS AND AVERAGE FISSION PRODUCT BETA CONCENTRATIONS IN AIR ($\mu\mu c/m^3$), MARCH 1962

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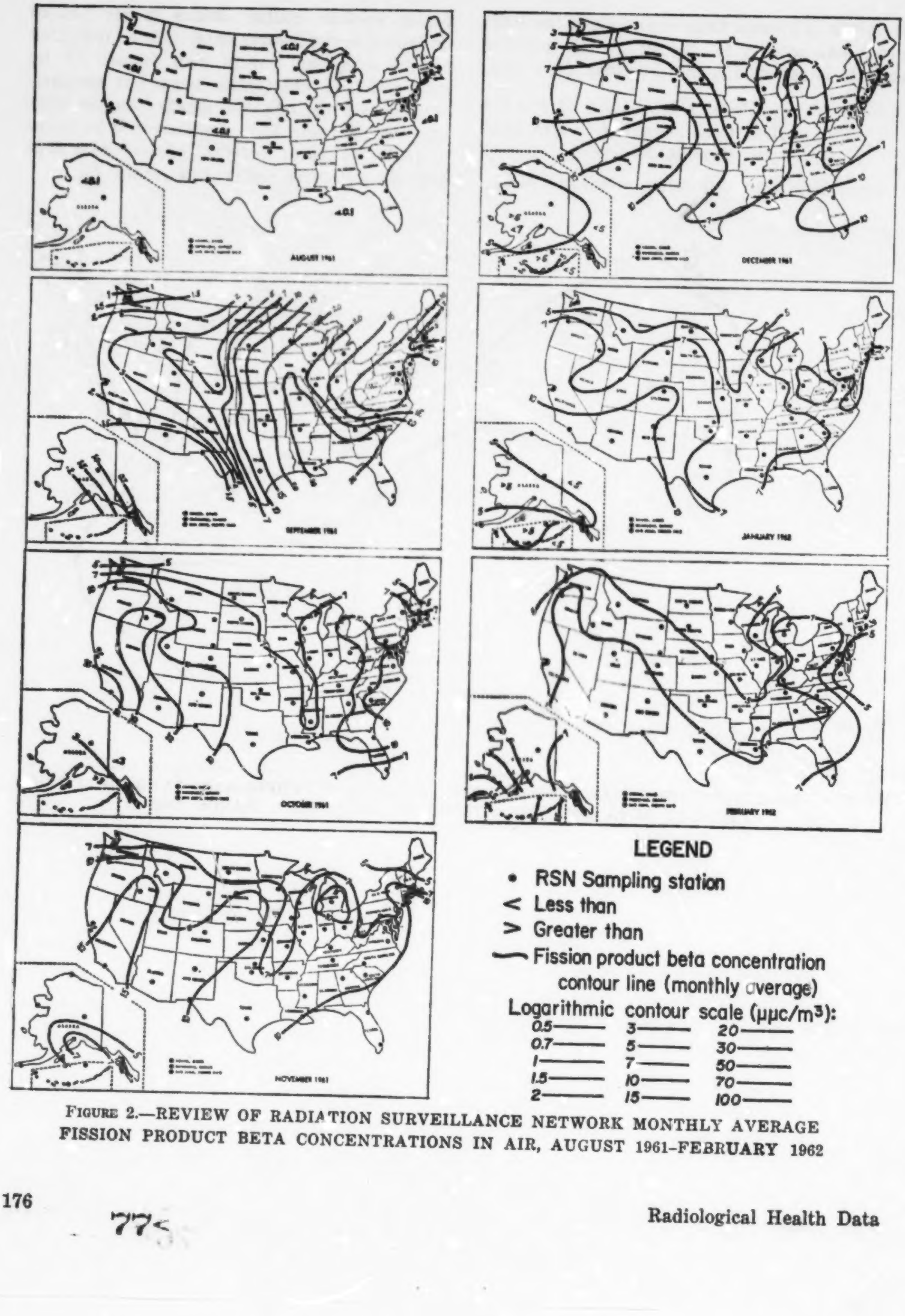
AUGUST 1961
DECEMBER 1961
SEPTEMBER 1961
JANUARY 1962
OCTOBER 1961
FEBRUARY 1962
NOVEMBER 1961
LEGEND
• RSN Sampling station
< Less than
> Greater than
Fission product beta concentration contour line (monthly average)
Logarithmic contour scale (µµc/m³):
0.5
0.7
1
1.5
2
3
5
7
10
15
20
30
50
70
100

FIGURE 2.—REVIEW OF RADIATION SURVEILLANCE NETWORK MONTHLY AVERAGE FISSION PRODUCT BETA CONCENTRATIONS IN AIR, AUGUST 1961–FEBRUARY 1962

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Surface Air Radon, Thoron, and Fission Product Gross Beta Concentrations at Cincinnati, Ohio

Division of Radiological Health, Public Health Service

The determination of natural background radiation in our atmosphere is useful because the exposure levels from natural radiation can be used as a base for comparative evaluations of exposures from artificially produced radionuclides. Natural radioactivity in surface air is attributed to a number of unstable nuclides other than those produced by man. The earth's crust contains trace amounts of uranium and thorium that occur naturally and which decay through a series of their daughter products. These decay products of uranium and thorium are introduced into surface air through their rare gas daughters, radon (radon-222) and thoron (radon-220), which in turn continue to decay through the uranium and thorium series, respectively. The radon and thoron content of air depends on the escape of these rare radioactive gases from the earth. Concentrations depend on prevailing atmospheric conditions such as ambient temperature, humidity, and pressure, and on soil conditions such as moisture, porosity, and temperature.

Most of the natural radioactivity in surface air is due to radon (Rn^{222}) and its daughters. Thoron (Rn^{220}) and its daughters contribute much less because of thoron's short half-life and hence, a lower diffusion rate from the soil.

Radiological Health Research Activities, Research Branch, Division of Radiological Health, Public Health Service, performs a continuous daily sampling program at Cincinnati for radon, thoron, and gross beta fission product concentrations in surface air. The airborne particulates, which include the daughter products of radon and thoron, are collected continuously on a membrane filter surface at a rate of approximately 1.2 cubic meters of air per hour.

Radon-222 concentrations are determined from alpha measurements made immediately after the sampling period (24 to 72 hours) has ceased. Radon-222 (a.m.) concentrations have been corrected for any radon-220 daughter interferences. Radon-222 (p.m.) concentrations are derived from alpha measurements made in the afternoon (3 p.m.) approximately 7 hours after the new sampling period has begun. These values are from the same filters that are counted at 8 a.m. the following day. Radon-222 (p.m.) concentrations are uncorrected for any radon-220 daughter interferences. Radon-220 concentrations are determined from alpha measurements made on the sample used to evaluate the corrected radon-222 (a.m.) concentrations, but are counted 7 hours after the sampling period has ceased. Reported values are corrected to the time of removal of the filter. The gross beta activity of airborne particulates, when measured several days after sample collection, is due principally to artificially-produced fission products.

The data are computed by an electronic data processing system which is programmed for

TABLE 1.—SURFACE AIR RADON (Rn^{222}), THORON (Rn^{220}), AND FISSION PRODUCT BETA CONCENTRATIONS AT CINCINNATI, OHIO, FEBRUARY 26–MARCH 23, 1962

End of sampling period	Rn^{222} 8 a.m. ($\mu\mu c/m^3$)	Rn^{222} 3 p.m. ($\mu\mu c/m^3$)	Rn^{220} ($\mu\mu c/m^3$)	Beta activity ($\mu\mu c/m^3$)
February 26	100	90	1.1	7.06
27	100	70	0.5	4.41
28	60	50	0.4	2.17
March 1	120	30	0.4	7.44
2	80	90	0.5	8.12
5	110	40	1.7	12.19
6	50	40	0.4	7.42
7	40	30	0.4	3.69
8	150	60	1.0	8.53
9	130	110	1.1	8.59
12	110	110	1.2	3.59
13	120	80	0.5	7.07
14	80	100	0.4	5.10
15	100	80	0.7	8.48
16	320	70	2.6	7.80
19	220	120	3.2	3.62
20	130	90	1.4	23.01
21	140	130	0.9	9.19
22	90	80	0.5	12.05
23	100	90	0.6	5.87
Average	122	81	1.2	7.54
Range of counting errors (2σ):				
Maximum	31	20	0.6	0.28
Minimum	11	9	0.2	0.06

thirteen four-week periods per calendar year. The data for the period February 26–March 23, 1962 appear in table 1.

REFERENCE

Setter, L. R. and G. I. Coats "The Determination of Airborne Radioactivity," *American Industrial Hygiene Association Journal*, 22, No. 1, Feb. 1961.

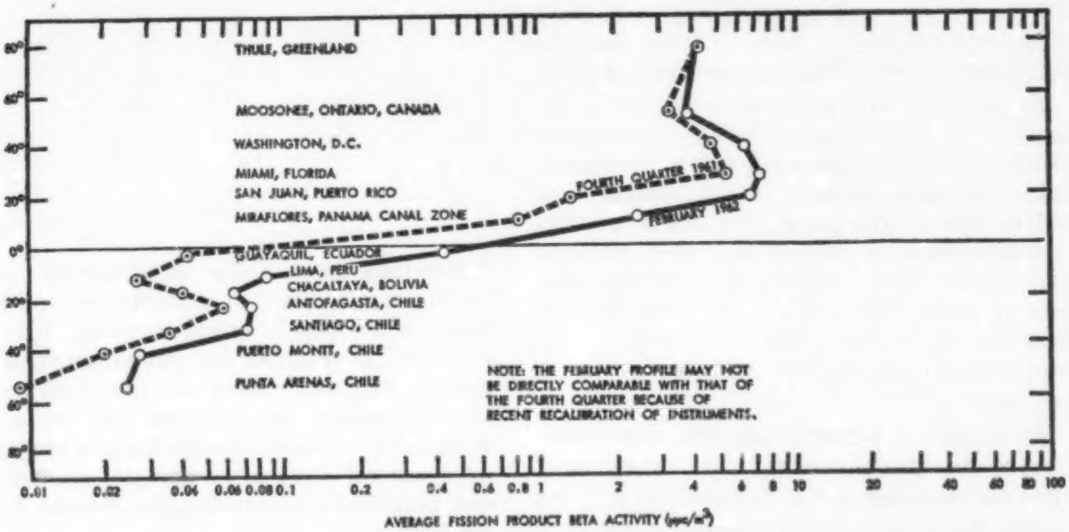
Radioactivity Measurements in Surface Air Near the 80th Meridian West

U.S. Naval Research Laboratory

Radioactivity measurements of surface air samples collected at various sites near the 80th Meridian West have been made since 1956. This program is operated by the U.S. Naval Research Laboratory with the cooperation of interested agencies of the United States, Canada, Ecuador, Peru, Bolivia, and Chile, which have made the actual sample collections and forwarded them to NRL for analysis. Partial financial support of this program is provided by the Division of Biology and Medicine, U.S. Atomic Energy Commission.

The sampling procedure involves drawing air continuously for a seven-day period at a rate of approximately 1200 cubic meters per day through high efficiency filters, 8 inches in diameter, using positive displacement blowers. After a sample is removed, it is forwarded immediately to NRL for assay of gross beta activity two weeks after collection.

The fission product concentrations in air during February 1962 are presented in table 1, and the radioactivity profile along the 80th Meridian West for the same month is shown in figure 1. This figure illustrates the data



NOTE: THE FEBRUARY PROFILE MAY NOT BE DIRECTLY COMPARABLE WITH THAT OF THE FOURTH QUARTER BECAUSE OF RECENT RECALIBRATION OF INSTRUMENTS.

FIGURE 1.—PROFILE OF BETA ACTIVITY, AVERAGE MEASUREMENT OF SURFACE AIR AT STATIONS NEAR THE 80TH MERIDIAN WEST, FOURTH QUARTER 1961 AND FEBRUARY 1962

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TABLE 1.—FISSION PRODUCT BETA ACTIVITY IN SURFACE AIR, NRL, FEBRUARY 1962[a]

[Average concentrations in $\mu\mu c$/liter]

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador	Miraflores, Panama Can. Z.	San Juan, P. R.	Mauna Loa, Hawaii[b]	Miami, Florida	Washington, D. C.	Moosonee, Ontario, Canada	Thule, Greenland
1														
2														
3	0.024	0.011	0.103	0.079	0.026	0.038	0.829	2.59	3.88	1.30	8.01	5.54	2.74	
4														4.49
5														
6														
7														
8														
9	[c]—	0.041	0.071	0.073	0.040	0.078	0.166	1.81	3.88	3.54	7.24	7.92	3.40	
10														3.84
11														
12														
13														
14														
15														
16	0.032	0.021	0.064	0.071	0.172	0.101	0.429	3.42	11.52	4.35	9.63	6.03	3.09	
17														4.04
18														
19														
20														
21														
22														
23	0.018	0.025	0.034	0.065	0.026	0.117	0.333	2.16	7.29	9.54	5.44	6.26	5.13	
24														3.54
25														
26														
27	0.028	0.026	0.028	0.137	0.030	0.108	0.098	2.68	7.29	6.08	4.34	5.85	5.54	
28														8.37
Weighted average	0.025	0.028	0.069	0.076	0.066	0.089	0.430	2.50	6.88	5.04	7.34	6.48	3.94	4.23

[a] The average concentration determined from a given sample is placed at the center of a rectangle which indicates the length and dates of the sampling period. Station averages for the month were determined by weighting the sample averages according to the number of days in the sampling period or that portion of the sampling period occurring in February 1962.

[b] Mauna Loa data has been included for comparison with Chacaltaya, Bolivia. Both are high elevation stations (3400 and 5200 meters) and about equally distant north and south of the equator.

[c] Dash indicates sample was not received.

plotted in semilogarithmic coordinates. The abscissa is expressed in micromicrocuries per cubic meter of surface air.

The gross beta measurements indicate the increasing penetration into the Southern Hemisphere of radioactivity from the 1961 Soviet nuclear test series. The evidence is clear from comparisons with the radioactivity records for 1960 and 1961 that this activity is appearing in some quantity as far south as Lima and Chacaltaya; for example, the gross beta radioactivity in February 1962 at these sites is about 5-fold higher than in February 1961, while at Guayaquil it is nearly 20 times greater this year.

It is reasonable to postulate that the mechanism by which this activity reaches the southern hemisphere is through the transequatorial exchange of tropospheric air masses from the two hemispheres.

SECTION II.—FOOD

Radioactivity of Leafy Vegetables and Grasses Exposed to Fallout Originating From U.S.S.R. Nuclear Atmospheric Tests

Food and Drug Administration

The Food and Drug Administration collected four groups of leafy vegetables and grasses during the months of September, October, and November 1961, when high concentrations of fission product beta activity in air were reported by the Public Health Service Radiation Surveillance Network. An attempt was made to ascertain these vegetation samples from the same general areas sampled by the Radiation Surveillance Network for gross beta concentrations in air. The results of analyses for "total beta" and "total gamma," corrected for the presence of naturally-occurring potassium-40, are presented in table 1. The values given for the leafy vegetables and grasses represent the concentrations on an original unwashed weight basis at the time of analysis.

Comparison of Beta Activity in Air and Vegetation

Plotted on the upper portion of figure 1 are the average gross beta (fission product) concentrations in air associated with each sampling group in this study. The numbers in parentheses indicate the number of air sampling locations represented by the average. Daily air samples were taken at each of these locations during the 14-day period ending approximately on the date of leafy vegetation collection. Plotted on the lower portion of figure 1 are the average concentrations of total beta in leafy vegetables and grasses collected at the end of the air sampling periods. Prior to September 15, the air levels obtained by the Radiation Surveillance Network remained at a fairly constant value of less than 0.1 $\mu\mu c/m^3$ as indicated in figure 1. Data on activity in leafy vegetation for this corresponding period is lacking in these areas, but it can be assumed that the absence of nuclear testing prior to September 1 would be reflected by relatively low levels on vegetation, as suggested by the dotted section of the graph shown in the lower portion of figure 1.

It may be assumed that the total beta concentrations in vegetation represent the integration of fallout (both in air and precipitation) over relatively long periods of time—six weeks or longer. The relative constancy of these concentrations after the initial increase (see figure 1) probably represents a balance between the decay of short-lived, and the accumulation of intermediate or long-lived radionuclides.

Figure 1 appears to demonstrate that sampling for gross beta concentrations in air can provide an early alerting mechanism for vegetation sampling even though their usefulness for predicting radioactivity concentrations in

TABLE 1.—RADIOACTIVITY OF RAW AGRICULTURAL PRODUCTS EXPOSED TO FALLOUT ORIGINATING FROM SOVIET NUCLEAR ATMOSPHERIC TESTS, FALL 1961

Group	Product	Sampling location	Activity of raw product		Gross beta in PHS air samples[3] (μμc/m³)
			Beta[1] (μμc/gm)	Gamma[2] (cpm/gm)	
Group I Collected: September 23-25 Analyzed: September 26-29	Grass	Jacksonville, Fla.	84	624	43 Jacksonville, Fla.
	Grass	Jacksonville, Fla.	111		
	Grass	Jacksonville, Fla.	6.8		
	Grass	Jacksonville, Fla.	108		
	Grass	Jacksonville, Fla.	75		
	Grass	Orangeburg Co., S. C.	29		65 Columbia, S. C.
	Grass	Orangeburg Co., S. C.	22		
	Collard greens	Orangeburg Co., S. C.	12		
	Grass (Bermuda)	Orangeburg Co., S. C.	11	120	
	Grass	Orangeburg Co., S. C.	13		
	Grass	Pulaski Co., Ark.	32		92 Little Rock, Ark.
	Cabbage	Pulaski Co., Ark.	0.45	1.92	
	Turnip greens	Pulaski Co., Ark.	10	64	
	Turnip greens	Pulaski Co., Ark.	10	64	
	Rape greens	Pulaski Co., Ark.	4.3		
	Turnip greens	Lawrence Co., Mo.	11	376	79 Jefferson City, Mo
	Celery cabbage	Green Co., Mo.	3.8		
	Lawn grass	Green Co., Mo.	36		
	Turnip greens	Webster Co., Mo.	8.8		
	Celery cabbage	Webster Co., Mo.	2.7		
	Cauliflower	Jackson Co., Miss.	5.4		89 Pascagoula, Miss.
	Soybean vines	Jackson Co., Miss.	12		
	Grass	Jackson Co., Miss.	19		
	Turnip greens	Jackson Co., Miss.	7.7		
	Collard greens	Jackson Co., Miss.	5.0		
	Kudzu vine	Jackson Co., Miss.	21	104	
	Grass	New Orleans, La.	31		75 New Orleans, La.
	Collard greens	New Orleans, La.	3.2		
	Mustard greens	New Orleans, La.	8.6		
	Okra	La Place, La.	0.63	0.96	
	Collard greens	Montgomery, Ala.	5.0	9.6	[4] 92 Montgomery, Ala.
	Sorghum cane	Montgomery, Ala.	1.8	104	
	Mustard greens	Montgomery, Ala.	23		
	Grass	Montgomery, Ala.	26		
	Turnip greens	Montgomery, Ala.	1.4		
	Grass	Atlanta, Ga.	48	192	46 Atlanta, Ga.
	Lespedeza hay	Atlanta, Ga.	40		
	Collard greens	Atlanta, Ga.	6.3		
	Soybean vines	Atlanta, Ga.	16		
	Crowder pea vines	Atlanta, Ga.	11		
Group II Collected: October 2 & 5 Analyzed: October 5 & 12	Turnip greens	Springfield, Ill.	5.0	24	32 Springfield, Ill.
	Grass	Springfield, Ill.	16	29	
	Turnip greens	Springfield, Ill.	6.8		
	Turnip greens	Springfield, Ill.	4.1		
	Mustard greens	Springfield, Ill.	5.0		
	Grass	Iowa City, Iowa	193	95	38 Iowa City, Iowa
	Cabbage	Iowa City, Iowa	3.2		
	Rape greens	Iowa City, Iowa	5.4		
	Alfalfa	Iowa City, Iowa	25		
	Turnip greens	Iowa City, Iowa	16	25	
	Leaf lettuce	Minneapolis, Minn.	41		33 Minneapolis, Minn.
	Romaine lettuce	Minneapolis, Minn.	64	122	
	Cabbage	Minneapolis, Minn.	0.45		
	Cabbage	Minneapolis, Minn.	0.45	3.7	
	Grass	Minneapolis, Minn.	22	336	
	Cabbage	Madison, Wis.	0.45		30 Madison, Wis.
	Leaf lettuce	Madison, Wis.	2.7		
	Grass	Madison, Wis.	204		
	Alfalfa	Madison, Wis.	19	18	
	Cabbage	Madison, Wis.	0.18		
	Collards	Jacksonville, Fla.	3.2		13 Jacksonville, Fla.
	Collards	Jacksonville, Fla.	3.2		
	Collards	Jacksonville, Fla.	1.6		
	Collards	Jacksonville, Fla.	2.2		
	Greens	Jacksonville, Fla.	2.0		
Group III (Precipitation) Collected: November 1 & 2 Analyzed: November 3 & 6	Turnip greens	Nashville, Tenn.	31	21	7 Nashville, Tenn.
	Mustard greens	Nashville, Tenn.	5.9		
	Greens	Ridgetop, Tenn.	15		
	Beet greens	Davidson Co., Tenn.	32	10	
	Chinese cabbage	Nashville, Tenn.	0.63	2.6	
	Mustard greens	Cave City, Ky.	9.5	13	10 Frankfort, Ky.
	Turnip greens	Cave City, Ky.	23		
	Savoy cabbage	Hart Co., Ky.	6.2		
	Kale	Hart Co., Ky.	6.8		
	Cabbage	Kessinger, Ky.	3.2		

TABLE 1.—RADIOACTIVITY OF RAW AGRICULTURAL PRODUCTS EXPOSED TO FALLOUT FROM SOVIET NUCLEAR ATMOSPHERIC TESTS, FALL 1961—Continued

Group	Product	Sampling location	Activity of raw product		Gross beta in PHS air ampmles[4] (μμc³m⁴)
			Beta[1] (μμc/gm)	Gamma[2] (cpm/gm)	
Group IV (Precipitation) Collected: November 17 & 18 Analyzed: November 21-23	Turnip greens	Wicomico Co., Md.	20		12
	Collards	Baltimore Co., Md.	6.3	167	
	Spinach	Baltimore Co., Md.	9.1		Baltimore, Md.
	Kale	Washington Co., Va.	3.7		13
	Turnip greens	Washington Co., Va.	7.2		
	Mustard greens	Botetourt Co., Va.	37		Washington, D. C.
	Cabbage	Pasquotank Co., N. C.	0.58	0.56	
	Cabbage	Norfolk Co., Va.	0.45		9
	Turnip greens	Somerset Co., Md.	13		
	Spinach	Dorchester Co., Md.	41	30	Gastonia, N. C.
	Lawn grass	Falls Church, Va.	—	190	

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[1] Measured on 400 mg of ash in a low background beta counter. Values corrected for the presence of K^{40}. Efficiency: 20%.

[2] Measured on 3½ liters of finely chopped raw product packed in a Marinelli beaker with a 400-channel gamma spectrometer. Gamma activity (counts per minute) defined as number of photons detected in the energy range of 0-1.9 Mev. Values corrected for background, for the presence of K^{40} (1.4 Mev peak), and the counting efficiency (12%).

[3] Average of 14 daily air samples with collection ending approximately on date of raw agricultural product collection.

[4] Based on preliminary field measurements, not official station of Radiation Surveillance Network.

vegetation at a later time is limited. It is recognized that in addition to the air parameter, precipitation, wind speed and direction, particle size, and fission product age are other equally important factors not considered in this study. *For this reason, figure 1 should not be used for prediction of beta concentrations in vegetation.*

Comparison to 1958

Lettuce and spinach samples were obtained in the Los Angeles area during November 1958 when northeasterly winds occurred following atmospheric nuclear weapons testing at the Nevada Test Site. A comparison of the average total beta concentration in the spinach and lettuce samples with the average concentration in all samples in Group I (average of fallout,

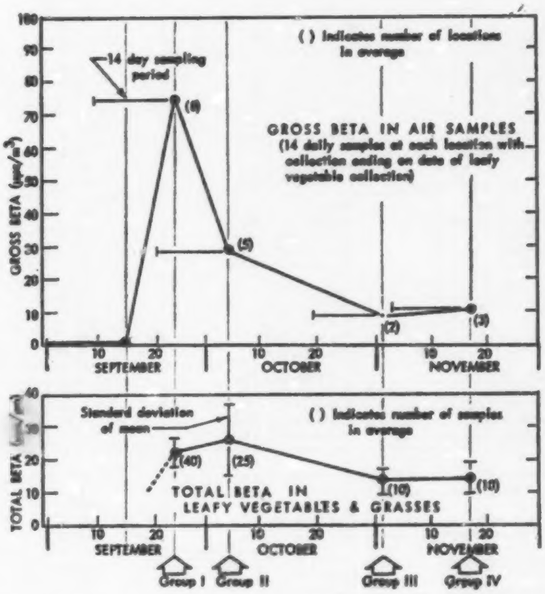

FIGURE 1.—COMPARISON OF AVERAGE TOTAL BETA ACTIVITY IN LEAFY VEGETABLES AND GRASSES AND IN AIR

1–2 weeks) shows: lettuce and spinach (1958), 33 μμc/gm; Group I (1961), 22.1 μμc/gm.

Strontium–90

Food and Drug Administration laboratory data on the relationship of strontium–90 to total beta in food samples support the assumption that the strontium–90 content of food samples containing fallout of an age 1 to 4 weeks old is on the order of 0.1 percent of the total beta measured. From this assumption, it is estimated that no strontium–90 concentration in any human food sampled in Groups I through IV in table 1 could lead to a daily ingestion in excess of 200 μμc (top of Range II, "Federal Radiation Council Report No. 2"), even if the item of food constituted the entire daily intake.

Iodine–131

From the presumed iodine–131 peaks of the 0 to 1.9 Mev gamma spectrum recorded by a 400–channel gamma spectrometer, iodine–131 was estimated to be not more than 5 percent of the total gamma for Group I. Using this estimate, turnip greens showing the highest total gamma reading would not have contained more than 8,000 μμc I^{131}/kg. Since the top of Range II given by the Federal Radiation Council Report No. 2 for iodine–131 is 100 μμc/day, it would be possible to reach this level of intake if 12.5 grams of turnip greens of the highest iodine–131 concentration were ingested daily. *It must be remembered also that such daily intake rates would have to be maintained for a year.*

Tri-City Diet Study[1]

Joseph Rivera
Health and Safety Laboratory, U.S. Atomic Energy Commission

Approximately every three months, since May 1960, estimates of the strontium–90 content of average diets for individuals living in New York City, San Francisco, and Chicago have been made by the Health and Safety Laboratory.

Selected foods, representing 19 food categories, are purchased at each of these three cities about every three months and are analyzed for strontium–90 and stable calcium. Using data from the U.S. Department of Agriculture, "Household Food Survey of 1955," the annual consumption by an individual can be grouped into the same 19 food categories. The annual dietary intake of strontium–90 and calcium can then be estimated by summing the contributions from each category. Some food types are assumed to be representative of larger food categories, such as liquid milk for dairy products in general. Hence, in the tables that follow, the values shown for food consumption may not be directly related to the original data in the source document.

The consumption data from the "Household Food Survey of 1955" are based on a "weight as purchased" basis. Before the food samples for the Tri-City Diet Study are ashed for radiochemical analysis, they are prepared to a certain degree, as if for actual consumption. Thus, fruits are peeled, eggs are shelled, poultry is de-boned, etc. The concentration of radioactivity in foods as reported in the Tri-City Diet Study is, therefore, based on the trimmed weight. No correction is made for the wasted food. Contributions of strontium–90 from tap water are not included in table 1, but measurements during 1960 and 1961 indicate the contribution would be in the range of 100 to 200 μμc Sr^{90} per year. It is assumed in making this estimate that the average daily intake of tap water is 1.2 liters.

Results obtained from the sixth sampling of foods (August–October 1961) are presented in table 1. The variation with time of the daily

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[1] Data from *Quarterly Summary Report, HASL–122*, April 1, 1962.

TABLE 1.—STRONTIUM-90 LEVELS OF DIET—SIXTH SAMPLING

Food type	Annual consumption	New York City August 1961		Chicago October 1961		San Francisco September 1961	
	(kg/yr)	µµc/kg	µµc/yr	µµc/kg	µµc/yr	µµc/kg	µµc/yr
Whole grain products	11	11.4	126	9.6	106	6.1	67
Refined grain products	37	5.8	215	5.9	218	2.0	73
Refined grain flour	43	6.2	267	5.5	236	1.8	76
Milk, liquid	221	7.8	1728	3.2	716	1.6	343
Potatoes	45	—	* 206	2.8	125	1.1	50
Macaroni	3	2.2	7	4.5	14	1.2	4
Beans, dried	3	2.6	8	11.1	33	6.8	20
Vegetables, canned	20	2.6	52	4.6	92	0.5	11
Vegetables, fresh	43	9.9	424	7.8	335	1.3	56
Vegetables, root	17	2.1	36	4.8	81	5.0	85
Fruit, canned	26	1.3	34	0.8	22	0.5	12
Fruit juices	19	2.8	54	2.2	43	1.3	24
Fruit, fresh	68	1.2	81	2.2	147	0.8	55
Rice	3	1.1	3	1.2	4	1.0	3
Eggs	16	0.7	11	1.9	31	1.6	26
Fish, fresh	8	0.6	5	0.4	4	0.2	1
Fish, shell	1	1.1	1	0.6	1	0.2	2
Meat	73	0.4	31	0.4	29	0.6	41
Poultry	17	0.7	11	1.6	27	0.8	14
Total annual intake			3300		2264		961

* Estimated.

intake of strontium-90 at the three cities is plotted in figure 1.

From the data in table 1, we see that the previously noted differences in the intake of strontium-90 at the three cities persist. New York City diets were highest in strontium-90 intake, Chicago diets were slightly lower than those in New York City, and San Francisco diets were considerably lower than those in New York City or Chicago. While these differences were principally due to differences in the strontium-90 content of milk consumed in the cities, some persistent differences in the strontium-90 content of flour are also noted. This is somewhat surprising since it was thought that the flour consumed at the three cities would come from the same general source, and that, therefore, the strontium-90 found in flour purchased at any of the cities would be about the same. The lower strontium-90 concentrations found in flour purchased in San Francisco suggest that it was milled from wheat locally grown, since wheat grown on the west coast is known to have a lower strontium-90 content than the national average.

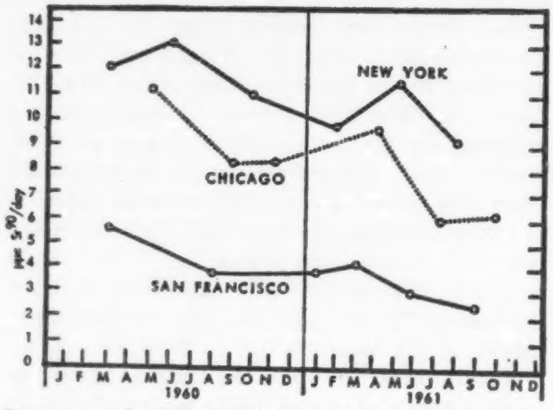

FIGURE 1.—DAILY INTAKE OF STRONTIUM-90 IN TRI-CITY DIETS

Two observations that may be made from figure 1 are that the daily strontium-90 intake at each of the cities during 1961 has generally declined and, superimposed on this general decline, there is evidence for a seasonal fluctuation with peak levels occurring during the spring months.

The seasonal dependence of strontium-90 intake levels are presumably due to a seasonal dependence of milk levels. We hope to be able to study these effects in more detail when we analyze foods that will be purchased in 1962, particularly in the spring when relatively heavy fallout is expected.

Using the totals given in table 1, the following average concentrations in µµc Sr^{90}/gm Ca may be expressed in units of annual intake: New York, 8.6; Chicago, 5.9; San Francisco, 2.5. This calculation was based on calcium data obtained from the first two sampling periods. Despite the fact that there is some variability in the results obtained from analyses of individual food categories, the total intake of calcium was calculated to be 383 grams per person per year with a standard deviation of less than 5 percent. Because of the relative constancy of the average annual intake of calcium due to its strong dependence on the relatively constant calcium content of milk, analyses of food categories, other than milk, for calcium were discontinued after the second sampling. Previous coverage in *Radiological Health Data*

Period	*Issue*
First Sampling (March–May 1960)	**April 1961**
Second Sampling (June-September 1960)	**June 1961**
Third Sampling (October 1960–January 1961)	**October 1961**
Fourth Sampling (February–April 1961)	**December 1961**
Fifth Sampling (May–July 1961)	**March 1962**

SECTION III.—MILK

Milk Monitoring Program

Division of Radiological Health
Division of Environmental Engineering and Food Protection
Public Health Service

Milk monitoring has been conducted by the Public Health Service since early 1957, when the first program was established to develop suitable sampling methods and radiochemical analytical proficiencies. Raw milk was initially selected for investigation. During this program, it became evident that a broader sampling program was necessary—one more directly related to the milk consumed by the population. The result was the initiation, in the first quarter of 1960, of a pasteurized milk sampling program designed to provide data representative of milk consumed in selected municipalities. Both programs were operated concurrently until June 1961 to permit comparison of the differences between the earlier, limited, milkshed sampling results and those of the new program.

Raw milk sampling results reported for June 1961 in the November 1961 *RHD* were the last regular publication of such data. A summary discussion of the raw milk sampling program in the December 1961 *RHD* presented the gross relationship between fallout and the occurrence of fission products in milk determined from this study.

During January 1962, the surveillance of pasteurized milk was conducted at 61 stations (shown in figure 1) with the cooperation of State and local milk sanitation agencies who ship samples to the PHS Southeastern and Southwestern Radiological Health Laboratories for analysis. The former analyzes samples from the 30 States generally east of the Mississippi River, and the latter analyzes samples from the western States. Publication in *RHD* follows about four months after sample collection because of time required for shipment, processing, decay-product buildup, data compilation, and publication procedures.

The current program emphasizes (1) measurement of the levels of radioactivity of samples of pasteurized milk consumed by the public in various regions of the country, and (2) provision of at least one sampling point within virtually all States and additional points when indicated by widely varying conditions of the milk supply or the need to cover large population groups. Each sample is composited in proportion to the volume of milk sold by those plants supplying not less than 90 percent of a city's milk supply. Prior to September 15, 1961, this composite sample was taken from one day's sales per month and was as representative of a community's total supply as could be achieved under practical conditions. Since

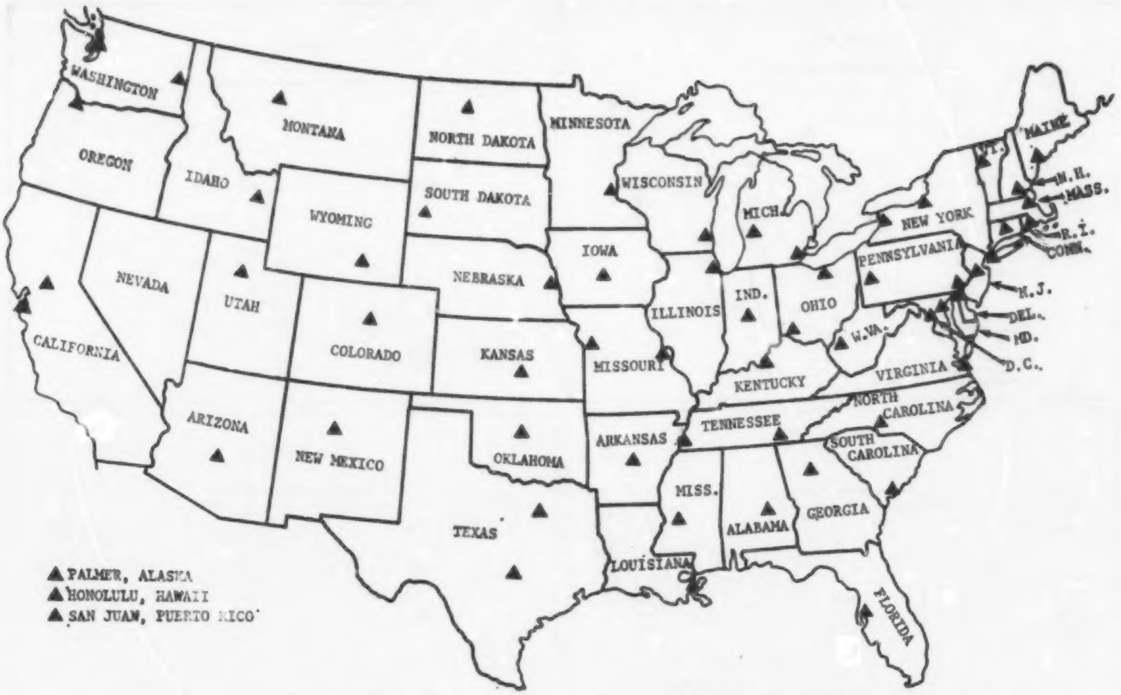
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
WISCONSIN
MICH.
NEW YORK
VT.
MAINE
N.H.
MASS.
R.I.
CONN.
PENNSYLVANIA
N.J.
DEL.
MD.
D.C.
NEVADA
UTAH
COLORADO
NEBRASKA
IOWA
ILLINOIS
IND.
OHIO
W.VA.
VIRGINIA
CALIFORNIA
KANSAS
MISSOURI
KENTUCKY
NORTH CAROLINA
TENNESSEE
ARIZONA
NEW MEXICO
OKLAHOMA
ARKANSAS
SOUTH CAROLINA
MISS.
ALABAMA
GEORGIA
TEXAS
LOUISIANA
FLORIDA
▲ PALMER, ALASKA
▲ HONOLULU, HAWAII
▲ SAN JUAN, PUERTO RICO

FIGURE 1.—PASTEURIZED MILK AREA SAMPLING STATIONS, JANUARY 1962

September 15, the sampling schedule has been accelerated.

During January 1962, sampling on a weekly basis was performed at most stations. Exceptions were Montgomery and Rapid City with one sample each and Burlington with two. All surveillance data is subject to continuing review and evaluation to observe unusual patterns or levels which may require immediate attention and adjustment in the pasteurized milk sampling program operation. Further atmospheric nuclear testing may require an immediate re-evaluation and readjustment of the sampling frequency and analytical schedule for this program.

Iodine–131, cesium–137, and barium–140 are

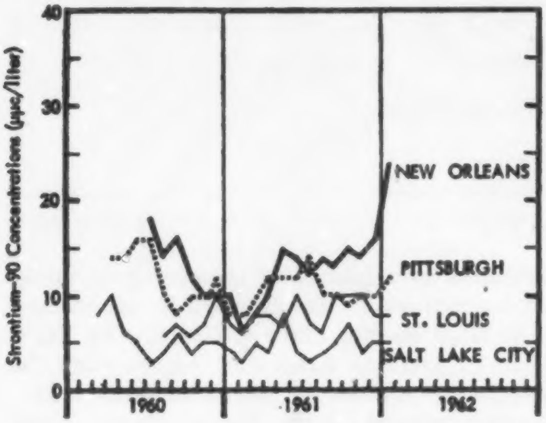

FIGURE 2.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

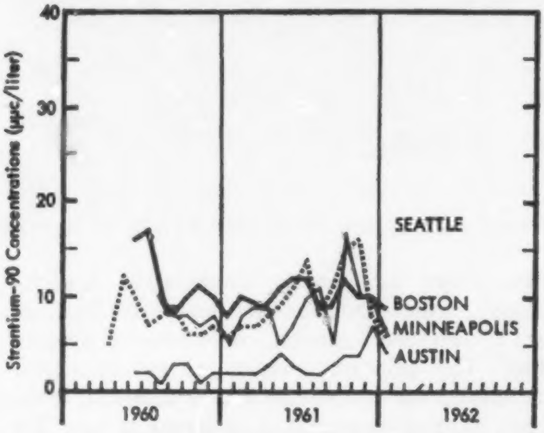

FIGURE 3.—STRONTIUM-90 CONCENTRATIONS IN PASTEURIZED MILK

88< [illegible]

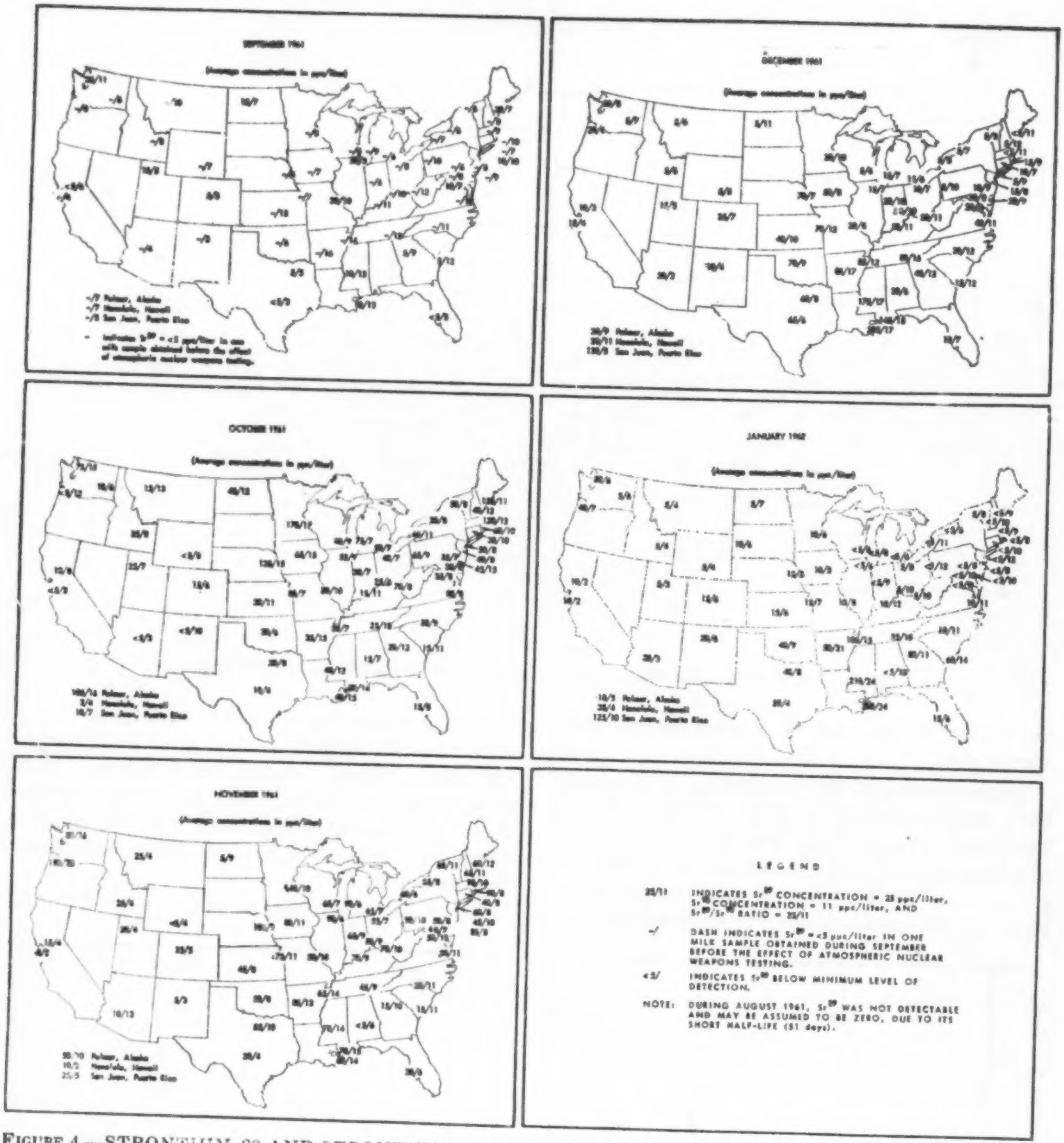
SEPTEMBER 1961
(Average concentrations in μμc/liter)
DECEMBER 1961
(Average concentrations in μμc/liter)
OCTOBER 1961
(Average concentrations in μμc/liter)
JANUARY 1962
(Average concentrations in μμc/liter)
NOVEMBER 1961
(Average concentrations in μμc/liter)
LEGEND
25/11 INDICATES Sr89 CONCENTRATION = 25 μμc/liter, Sr90 CONCENTRATION = 11 μμc/liter, AND Sr89/Sr90 RATIO = 25/11
–/ DASH INDICATES Sr89 = <5 μμc/liter IN ONE MILK SAMPLE OBTAINED DURING SEPTEMBER BEFORE THE EFFECT OF ATMOSPHERIC NUCLEAR WEAPONS TESTING.
<5/ INDICATES Sr89 BELOW MINIMUM LEVEL OF DETECTION.
NOTE: DURING AUGUST 1961, Sr89 WAS NOT DETECTABLE AND MAY BE ASSUMED TO BE ZERO, DUE TO ITS SHORT HALF-LIFE (51 days).

FIGURE 4.—STRONTIUM-89 AND STRONTIUM-90 CONCENTRATIONS (Sr^{89}/Sr^{90}) IN PASTEURIZED MILK

determined by gamma scintillation spectroscopy, while strontium-89 and strontium-90 are determined following radiochemical separation. The minimum levels of detection for strontium-89, strontium-90, iodine-131, cesium-137, and barium-140 in terms of μμc/liter are 5, 1, 10, 5, and 10, respectively.

The May 1962 *RHD* (page 151) published a graphical presentation of the average monthly concentrations of strontium-90 in pasteurized milk from selected cities (Atlanta, New York, Chicago, and San Francisco) representing the population centers of the four major geographic regions of the United States. These regions correspond to those used by the Department of Agriculture for their tabulations

TABLE 1.—RADIOACTIVITY IN PASTEURIZED MILK, JANUARY 1962

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month	Fourth quarter	Av. for month
Montgomery	Ala.	1.22	1.06	10	<5	6	10	30	<10	<5	30	20	20
Palmer	Alaska	1.10	1.04	60	10	12	5	130	<10	15	5	40	<10
Phoenix	Ariz.	1.05	1.02	10	30	6	3	50	10	5	5	<10	<10
Little Rock	Ark.	1.20	1.20	70	50	15	21	100	<10	20	10	30	20
Sacramento	Calif.	1.13	1.02	10	10	5	2	20	<10	10	<5	<10	<10
San Francisco	Calif.	1.09	1.08	10	10	3	2	20	20	5	5	<10	<10
Denver	Colo.	1.10	1.01	20	15	6	6	50	10	10	10	10	<10
Hartford	Conn.	1.17	1.16	25	<5	8	10	30	<10	10	<5	30	<10
Wilmington	Del.	1.17	1.16	50	<5	11	10	40	<10	5	<5	30	<10
Washington	D. C.	1.17	1.14	35	<5	9	9	30	<10	5	<5	20	<10
Tampa	Fla.	1.22	1.22	20	15	6	6	30	<10	70	50	20	<10
Atlanta	Ga.	1.20	1.17	25	80	11	11	50	<10	[a] 5	<5	20	20
Honolulu	Hawaii	1.07	1.04	10	35	6	4	20	<10	15	5	<10	<10
Idaho Falls	Idaho	1.05	1.04	25	5	6	4	80	<10	10	5	10	<10
Chicago	Ill.	1.18	1.11	80	<5	7	6	80	<10	[a] 10	<5	40	<10
Indianapolis	Ind.	1.21	1.20	40	<5	9	9	50	<10	<5	<5	20	<10
Des Moines	Iowa	1.06	1.03	65	10	11	5	180	10	10	10	20	<10
Wichita	Kans.	1.06	1.02	40	15	10	6	100	10	10	<5	10	<10
Louisville	Ky.	1.19	1.19	45	10	11	12	60	<10	<5	10	30	<10
New Orleans	La.	1.26	1.24	105	300	15	24	60	<10	15	40	40	60
Portland	Maine	1.19	1.20	60	<5	11	9	50	<10	20	20	40	<10
Baltimore	Md.	1.17	1.16	35	<5	8	10	40	<10	<5	10	20	<10
Boston	Mass.	1.18	1.19	70	<5	11	9	60	<10	10	25	40	<10
Detroit	Mich.	1.17	1.16	40	<5	7	6	100	<10	5	<5	30	<10
Grand Rapids	Mich.	1.19	1.19	60	<5	7	8	50	<10	<5	<5	30	<10
Minneapolis	Minn.	1.10	1.03	110	10	12	6	170	<10	15	5	40	<10
Jackson	Miss.	1.28	1.28	95	210	14	24	70	<10	5	20	40	50
Pascagoula	Miss.	1.27	[b] NS	80	NS	16	NS	60	NS	10	NS	30	NS
Kansas City	Mo.	1.06	1.01	75	15	10	7	130	10	15	5	20	<10
St. Louis	Mo.	1.08	1.02	35	10	9	8	90	<10	10	10	10	<10
Helena	Mont.	1.07	1.06	15	5	8	4	100	<10	20	<5	10	<10
Omaha	Nebr.	1.08	1.03	100	15	10	5	140	<10	10	<5	30	<10
Manchester	N. H.	1.20	1.16	35	<5	12	10	50	<10	25	20	40	<10
Trenton	N. J.	1.19	1.15	35	<5	9	8	40	<10	<5	<5	20	10
Albuquerque	N. Mex.	1.09	1.03	5	20	6	6	30	10	10	5	<10	<10
Buffalo	N. Y.	1.12	1.12	35	<5	8	11	40	<10	5	<5	20	<10
New York	N. Y.	1.13	1.12	40	<5	8	12	50	<10	5	<5	30	<10
Syracuse	N. Y.	1.16	1.15	50	<5	7	6	60	<10	10	<5	40	<10
Charlotte	N. C.	1.27	1.21	25	10	11	11	20	<10	<5	<5	20	<10
Minot	N. D.	1.09	1.02	15	5	11	7	60	<10	10	5	<10	<10
Cincinnati	Ohio	1.22	1.19	50	5	8	10	70	<10	<5	<5	30	<10
Cleveland	Ohio	1.18	1.17	35	5	7	8	50	<10	5	<5	20	<10
Oklahoma City	Okla.	1.18	1.18	60	40	8	9	100	<10	10	<5	20	10
Portland	Oreg.	1.05	1.02	70	40	17	7	80	<10	25	10	20	<10
Philadelphia	Pa.	1.20	1.12	30	<5	8	8	40	<10	<5	<5	20	<10
Pittsburgh	Pa.	1.16	1.18	40	<5	10	12	40	<10	5	<5	30	<10
San Juan	P. R.	1.18	1.13	55	125	6	10	20	<10	10	10	20	30
Providence	R. I.	1.18	1.16	55	<5	9	8	50	10	10	10	30	<10
Charleston	S. C.	1.22	1.22	15	60	11	14	30	<10	20	20	20	10
Rapid City	S. D.	NS	1.09	NS	10	NS	6	NS	<10	NS	15	NS	<10
Chattanooga	Tenn.	1.27	1.25	50	55	12	10	50	<10	5	15	20	20
Memphis	Tenn.	1.24	1.20	60	105	11	15	90	<10	10	<5	20	30
Austin	Tex.	1.18	1.14	30	20	5	4	40	<10	[a] <5	<5	20	10
Dallas	Tex.	1.23	1.24	45	40	9	8	50	<10	[a] <5	<5	20	10
Salt Lake City	Utah	1.11	1.07	20	5	5	5	60	10	10	10	10	10
Burlington	Vt.	1.18	1.16	40	5	9	8	50	<10	10	20	30	<10
Norfolk	Va.	1.23	1.20	60	10	10	11	40	<10	5	<5	20	<10
Seattle	Wash.	1.11	1.02	60	20	13	6	80	10	20	15	20	<10
Spokane	Wash.	[a] 1.12	1.02	[a] 10	5	[a] 6	6	60	<10	15	10	10	<10
Charleston	W. Va.	1.18	1.16	55	5	10	10	30	<10	<5	<5	20	<10
Milwaukee	Wis.	1.17	1.20	35	<5	7	6	80	<10	15	10	30	<10
Laramie	Wyo.	1.09	1.03	<5	5	6	4	30	10	15	15	10	<10
Network average		1.16	1.12	43	25	9	8.5	61	<10	11	9	22	<10

[a] Average based on two months.
[b] NS indicates no sample.

of average "per person" quantities of foods consumed per week, as presented in the August, September, and October 1960 *RHD*. Figures 2 and 3 graphically show the data for eight additional cities selected from these regions. This procedure will be accelerated in future issues so that all cities in the program will be shown.

Figure 4 shows the strontium–89 and strontium–90 concentrations for September 1961 through January 1962 plotted on outline maps

TABLE 2.—ANNUAL SUMMARIES OF RADIOACTIVITY IN PASTEURIZED MILK, 1960–61

[Average radioactivity concentrations in $\mu\mu c$/liter]

Area		Calcium (gm/liter)		Strontium-89		Strontium-90		Iodine-131		Cesium-137		Barium-140	
City	State	1960[a]	1961	1960[a]	1961	1960[a]	1961	1960[a]	1961	1960[a]	1961	1960[a]	1961
Montgomery[b]	Ala.	[c]—	1.22	—	<5	—	6	—	<10	—	<5	—	<10
Palmer	Alaska	1.07	1.08	<5	15	7	8	<10	30	<5	10	<10	10
Phoenix	Ariz.	1.02	1.04	<5	<5	4	4	<10	10	15	<5	<10	<10
Little Rock	Ark.	1.20	1.12	<5	20	13	16	<10	30	<5	15	<10	<10
Sacramento	Calif.	1.06	1.01	<5	<5	5	4	<10	<10	<5	5	<10	<10
San Francisco	Calif.	1.12	0.96	<5	<5	4	4	<10	<10	<5	5	<10	<10
Denver	Colo.	1.10	1.05	<5	5	7	6	<10	20	10	10	<10	<10
Hartford	Conn.	1.19	1.17	<5	5	9	8	<10	<10	10	15	<10	<10
Wilmington	Del.	1.21	1.19	<5	15	8	9	<10	10	10	10	<10	<10
Washington	D. C.	1.17	1.18	<5	10	8	8	<10	10	<5	10	<10	<10
Tampa	Fla.	1.26	1.24	<5	<5	5	6	<10	10	10	65	<10	<10
Atlanta	Ga.	1.24	1.12	<5	5	10	10	<10	20	<5	10	<10	<10
Honolulu	Hawaii	1.07	1.03	<5	<5	5	4	<10	<10	20	10	<10	<10
Idaho Falls	Idaho	1.07	1.04	<5	5	5	6	<10	20	20	5	<10	<10
Chicago	Ill.	1.15	1.06	<5	15	6	6	<10	30	<5	10	<10	10
Indianapolis	Ind.	1.20	1.22	<5	10	6	[illegible]	<10	10	<5	5	<10	<10
Des Moines	Iowa	1.04	1.05	<5	15	8	8	<10	50	15	5	<10	<10
Wichita	Kans.	1.08	1.05	<5	10	6	8	<10	30	<5	10	<10	<10
Louisville	Ky.	1.19	1.18	<5	10	9	10	<10	20	<5	5	<10	<10
New Orleans	La.	1.25	1.29	<5	30	13	12	<10	20	<5	15	<10	10
Portland	Maine	1.14	1.11	<5	15	11	9	<10	10	15	25	<10	10
Baltimore	Md.	1.16	1.21	<5	10	8	8	<10	10	<5	10	<10	<10
Boston	Mass.	1.19	1.21	<5	20	12	9	<10	20	15	20	<10	10
Detroit	Mich.	1.16	1.18	<5	10	7	6	<10	30	<5	5	<10	10
Grand Rapids	Mich.	1.25	1.21	<5	15	7	6	<10	10	5	5	<10	10
Minneapolis	Minn.	1.05	1.06	<5	30	8	9	<10	40	<5	10	<10	10
Jackson	Miss.	1.31	1.10	<5	15	12	12	<10	30	<5	10	<10	10
Pascagoula[b]	Miss.	—	1.27	—	20	—	16	—	30	—	10	—	<10
Kansas City	Mo.	1.06	1.05	<5	20	8	8	<10	30	10	10	<10	<10
St. Louis	Mo.	1.05	1.06	<5	10	7	8	<10	40	35	15	<10	<10
Helena	Mont.	1.08	1.04	<5	<5	6	6	<10	30	10	10	<10	<10
Omaha	Nebr.	1.04	1.08	<5	25	7	7	<10	40	5	15	<10	10
Manchester	N. H.	1.22	1.22	<5	10	10	10	<10	10	25	30	<10	10
Trenton	N. J.	1.22	1.18	<5	10	8	8	<10	10	5	5	<10	<10
Albuquerque	N. Mex.	1.10	1.07	<5	<5	4	5	<10	<10	5	5	<10	<10
Buffalo	N. Y.	1.18	1.16	<5	10	7	8	<10	10	<5	10	<10	<10
New York	N. Y.	1.14	1.15	<5	10	9	8	<10	30	5	15	<10	10
Syracuse	N. Y.	1.23	1.18	<5	15	7	7	<10	20	10	10	<10	10
Charlotte	N. C.	1.23	1.26	<5	5	12	11	<10	<10	5	10	<10	<10
Minot[b]	N. D.	—	1.08	—	<5	—	10	—	20	—	10	—	<10
Cincinnati	Ohio	1.18	1.22	<5	15	8	8	<10	20	<5	<5	<10	<10
Cleveland	Ohio	1.16	1.19	<5	10	8	7	<10	10	<5	5	<10	<10
Oklahoma City	Okla.	1.18	1.22	<5	15	8	7	<10	30	<5	5	<10	<10
Portland	Oreg.	1.12	1.08	<5	20	10	12	<10	20	20	20	<10	<10
Philadelphia	Pa.	1.17	1.21	<5	10	8	8	<10	10	10	10	<10	<10
Pittsburgh	Pa.	1.22	1.10	<5	10	12	10	<10	10	5	10	<10	<10
San Juan	P. R.	1.16	1.18	<5	15	4	4	<10	<10	<5	5	<10	<10
Providence	R. I.	1.21	1.19	<5	15	11	10	<10	10	10	25	<10	10
Charleston	S. C.	1.27	1.26	<5	<5	10	11	<10	10	5	20	<10	<10
Chattanooga	Tenn.	1.31	1.30	<5	15	10	11	<10	10	<5	10	<10	<10
Memphis	Tenn.	1.26	1.27	<5	15	10	11	<10	30	<5	5	<10	<10
Austin	Tex.	1.18	1.22	<5	10	2	3	<10	10	5	<5	<10	<10
Dallas	Tex.	1.23	1.23	<5	10	6	7	<10	10	<5	5	<10	<10
Salt Lake City	Utah	1.09	1.08	<5	5	5	5	<10	30	5	5	<10	<10
Burlington	Vt.	1.20	1.19	<5	10	9	8	<10	10	10	10	<10	<10
Norfolk	Va.	1.20	1.23	<5	15	9	9	<10	10	<5	10	<10	<10
Seattle	Wash.	1.09	1.07	<5	15	8	10	<10	20	30	15	<10	<10
Spokane	Wash.	1.09	1.07	<5	<5	7	8	<10	20	20	15	<10	<10
Charleston	W. Va.	1.19	1.08	<5	15	9	9	<10	<10	<5	5	<10	<10
Milwaukee	Wis.	1.17	1.19	<5	10	6	6	<10	20	<5	10	<10	<10
Laramie	Wyo.	1.06	1.05	<5	<5	5	6	<10	<10	10	10	<10	<10
Network average		1.16	1.14	<5	10	8	8	<10	20	10	10	<10	<10

[a] Averages based on 10 months' data or less.

[b] Dash indicates station not in operation during the year.

[c] Station began sampling after the resumption of atmospheric nuclear weapons testing. Sr^{89}, I^{131}, and Ba^{140} averages were calculated by assuming monthly concentrations for the period January–August 1961 were equal to zero.

of the United States. These figures show the increase of strontium-89 (half-life = 51 days) in pasteurized milk following the resumption of nuclear weapons testing in the atmosphere. They also show a reduction of strontium-89 in certain areas of the country where dairy cattle were fed during the winter on silage harvested prior to the resumption of atmospheric nuclear weapons testing.

Table 1 presents a summary of all available analyses for January 1962. These data are averages of weekly samples in most instances.

When a radionuclide was not detectable, one-half of the minimum level of detection was used for averaging.

Table 2 presents the 1960 and 1961 annual summaries. The 1960 averages are based on a maximum of 10 months' data since the first stations began sampling during March 1960. During most months of 1960, strontium-89, iodine-131, and barium-140 were not detectable. Therefore, the averages are indicated as being "less than" the minimum level of detection. During September, 1961, nuclear testing in the atmosphere was resumed, causing detectable concentrations of the short-lived nuclides, (strontium-89, iodine-131, and barium-140) to appear in pasteurized milk. The 1961 averages for strontium-89 (half-life, 51 days), Iodine-131 (half-life, 8.1 days), and barium-140 (half-life, 12.8 days), were calculated using zero for the concentrations during January through August 1961, and one-half of the minimum level of detection for the months in the period of September through December 1961, in which the radionuclide was not detectable. In some instances, September data were not used for averaging. The short-lived nuclides were not detected during the first half of September but were detected during the last half. For this reason the 1961 averages, for those stations which did not have a pasteurized milk sample analyzed during the last two weeks of September, were based on 11 months' data.

Radioactivity in Milk[1]

Health and Safety Laboratory
U.S. Atomic Energy Commission

In 1954, the Health and Safety Laboratory (HASL) began monitoring liquid whole milk in New York City for strontium-90 in order to estimate the potential hazard resulting from the contamination of foods by fallout. Subsequently, powdered milk monitoring was initiated at Mandan, North Dakota, and Perry, New York. Monitoring of liquid whole milk from two dairies in Honolulu, Hawaii, began in August 1959.

The New York City pasteurized liquid milk sample is a monthly composite of daily quart samples purchased in stores. Five large dairies are represented by purchases in rotation during the month. Weekly samples of pasteurized milk are collected from two dairies in Hawaii. Five-pound samples of powdered milk, collected from plants at Perry and Mandan, are composited at HASL on a monthly basis. The Perry sample is powdered whole milk for human consumption; the Mandan sample is powdered buttermilk used for cattle feed. The Honolulu samples are of interest since the cows are on pasture throughout the year and soil analyses have shown strontium-90 concentrations in soils in Hawaii comparable to those of the New York area.

Beginning September 1961, strontium-89 was measurable, indicating that fresh fission products from the USSR atmospheric nuclear weapons tests were being deposited. The Sr^{89}/Sr^{90} ratios are presented in table 1. The reduction in this ratio during December at Mandan can be attributed to the effect of winter silage harvested prior to the resumption of testing. Table 1 also presents the strontium-90 and calcium data for August-December 1961. Figures 1 and 2 show the fluctuations of strontium-90 concentrations with respect to time. [*Editor's note: Powdered milk when prepared for consumption contains approximately 0.1 kg milk powder per liter of liquid, therefore, the Perry powdered milk strontium-90 concentration during November 1961 would be about 4.6 μμc/liter.*]

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[1] Data from Quarterly Summary Reports, *HASL-122*, April 1, 1962.

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TABLE 1.—STRONTIUM-90 AND CALCIUM IN MILK SAMPLES, AUGUST–DECEMBER 1961

Sampling station and period	Calcium		Strontium-90			Sr^{89}/Sr^{90}
	gm/liter	gm/kg powder	μμc/liter	μμc/kg powder	μμc/gm Ca	
Perry, New York (powdered milk):						
1959 average					8.0	
1960 average					6.5	
August 1961		8.4		48	5.8	[a] 0
September		9.7		63	6.5	2.5
October		9.6		55	5.8	2
November		9.0		46	5.1	6
December		—		—	—	—
New York, New York (liquid milk):						
1959 average					11.0	
1960 average					8.0	
August 1961			5.4		5.4	0
September			5.2		5.2	0
October			6.0		6.0	12
November			6.1		6.1	4
December			5.7		5.7	1.5
Mandan, North Dakota (powdered buttermilk):						
1959 average					25.7	
1960 average					15.0	
August 1961		9.7		71	7.4	0
September		8.4		43	5.1	0
October		10.7		85	8.0	3
November		11.1		104	9.4	6
December		11.6		99	8.5	3
Honolulu, Hawaii[b] (liquid milk):						
1959 average					5.0	
1960 average					3.2	
August 1961					2.4	0
September					2.7	2
October					2.8	3.5
November					2.6	5.5
December					2.6	10

[a] Strontium-89 undetectable.
[b] Average of two dairies.

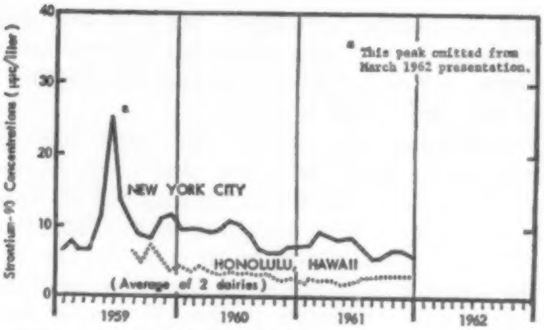

FIGURE 1.—STRONTIUM-90 IN LIQUID MILK SAMPLES

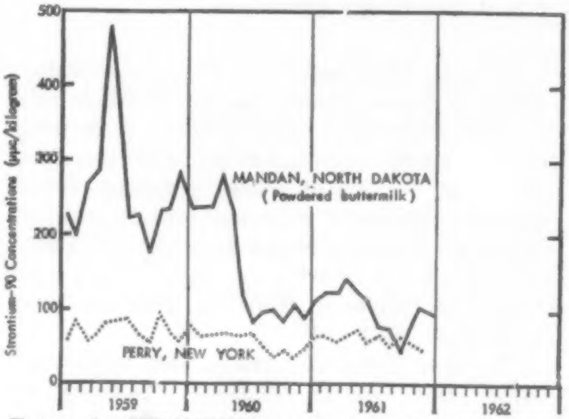

FIGURE 2.—STRONTIUM-90 IN POWDERED MILK SAMPLES

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SECTION IV.—WATER

National Water Quality Network

Division of Water Supply and Pollution Control, Public Health Service

The National Water Quality Network operates under the provision of Section 4 (c) of the Federal Water Pollution Control Act, which states "... The Secretary shall ... collect and disseminate basic data ... (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local agencies and industrial organizations, commenced operations in October 1957. During December 1961, 95 sampling stations submitted water samples for analyses. These stations are located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial, and other uses. Some of these stations are on interstate, coastal, and international boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately, a total of approximately 300 stations will be in operation. Radioactivity is not yet being reported for a few of the more recently established stations.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some, continuous composite samples of 10 to 15 days are obtained.

Gross alpha and beta measurements are made on both suspended and dissolved solids (strontium-90 on the total solids only) in raw surface water samples. The levels of radioactivity associated with dissolved solids provide a rough measure of the levels which may be found in treated water, where such water treatment removes substantially all of the suspended matter. Naturally-occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing for a period of three years, the beta activity in most raw waters generally had approached a level attributable solely to natural sources. Natural beta activity can be two or three times the natural alpha activity based on the presence of the same nuclides. The resumption of nuclear testing in the atmosphere by the U.S.S.R. has resulted in an increase in radioactivity of surface waters.

For the first two years of the Network operations, beta determinations were made on weekly samples. Alpha determinations were reported generally on composites of more than one weekly sample. Since January 1959, a portion of each sample from all stations in the Network has been composited into a three-

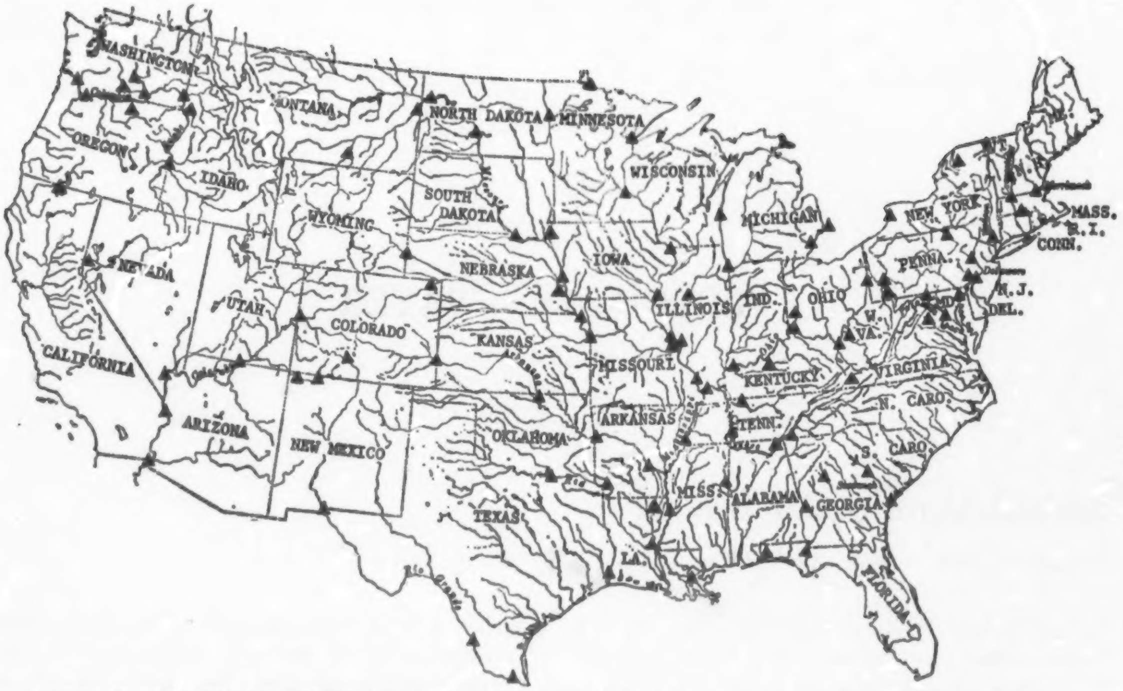
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LA.
WISCONSIN
ILLINOIS
MISS.
MICHIGAN
IND.
OHIO
KENTUCKY
TENN.
ALABAMA
GEORGIA
FLORIDA
S. CARO.
N. CARO.
VIRGINIA
W. VA.
PENNA.
NEW YORK
MASS.
R.I.
CONN.
N.J.
DEL.
MD.

FIGURE 1.—NATIONAL WATER QUALITY NETWORK SAMPLING STATIONS, DECEMBER 1961

month sample for measurement of strontium-90 concentration.

Beginning January 1, 1960, the frequency of beta determinations varied depending on the status of each particular station. For the first operating year of each new station, analyses were being conducted weekly. Weekly analyses were to be continued indefinitely for all stations which may be affected by waste discharges from nuclear installations. Semimonthly determinations (on composites of 2 or 3 weekly samples) were conducted for stations which still showed some beta activity above background. Monthly determinations (on composites of all samples received from a station during the month) were conducted on samples from streams where beta activity was at background levels.

Beginning January 1, 1960, the frequency of alpha determinations also was changed. For the first operating year of each new station, analyses were to be done weekly. At some stations on the Colorado and Animas Rivers determinations were done on weekly samples or semimonthly on two- or three-week composites. The remainder of the stations were scheduled so that each made one gross alpha determination per month.

Following the resumption of nuclear weapons testing in the atmosphere by the U.S.S.R., the gross beta and alpha determination schedules were altered. Beginning September 1, 1961, gross beta determinations were made on all samples collected (compositing weekly samples for monthly or semimonthly gross beta or alpha determinations will cease). Beginning October 1, 1961, gross alpha determinations were made on one sample from each station each month, unless there is evidence of alpha activity in excess of background levels. In the latter instance, an alpha determination were made on a weekly or bi-weekly basis, depending on what is considered the norm for a particular station.

All data reported in table 1 represent the average of all data reported for the period indicated. The reported strontium-90 data are the results of determinations on three-month

TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS

[Average concentrations in $\mu\mu c$/liter]

Station	Quarter ending Sept. 30, 1961	December 1961					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Allegheny River: Pittsburgh, Pa.	0.3	—	—	—	—	—	—
Animas River: Cedar Hill, N. Mex.	0.3	22	32	54	4	10	14
Apalachicola River: Chattahoochie, Fla.	0.4	1	4	5	0	0	0
Arkansas River:							
Coolidge, Kansas	2.3	20	89	109	4	42	46
Ponca City, Okla.	[a] —	45	61	106	0	0	0
Pendleton Ferry, Ark.	—	37	34	71	—	—	—
Big Horn River: Hardin, Mont.	—	8	27	35	1	10	11
Big Sioux River: Sioux Falls, S. Dak.	0.4	18	58	76	<1	<1	1
Chattahoochie River:							
Atlanta, Ga.	—	16	13	29	0	0	0
Columbis, Ga.	—	15	14	29	0	0	0
Clear Water River: East Lewiston, Idaho	—	29	33	62	0	<1	<1
Colorado River:							
Loma, Colo.	—	26	40	66	3	9	12
Boulder City, Nev.	1.0	4	22	26	<1	8	8
Parker Dam, Calif.	—	6	24	30	0	6	6
Yuma, Ariz.	—	11	40	51	3	1	4
Columbia River:							
Wenatchee, Wash.	—	3	7	10	0	1	1
Pasco, Wash.	1.1	104	678	782	—	—	—
Bonneville Dam, Oreg.	[b] 0.6	29	423	452	—	—	—
Clatskanie, Oreg.	—	27	74	101	0	0	0
McNary Dam, Oreg.	1.2	198	331	529	0	1	1
Connecticut River:							
Northfield, Mass.	0.4	9	15	24	—	—	—
Wilder, Vt.	—	13	23	36	0	0	0
Cumberland River: Clarksville, Tenn.	0.4	48	28	76	1	0	1
Delaware River:							
Martins Creek, Pa.	—	13	22	35	0	0	0
Trenton, N. J.	—	24	22	46	0	0	0
Escambia River: Century, Fla.	[b] 0.9	13	14	27	0	0	0
Great Lakes:							
Buffalo, N. Y.	—	12	10	22	1	0	1
Detroit, Mich.	[b] 0.6	7	13	20	0	0	0
Port Huron, Mich.	0.4	1	4	5	0	0	0
Milwaukee, Wis.	—	3	9	12	0	1	1
Sault Ste. Marie, Mich.	—	4	5	9	0	1	1
Gary, Ind.	0.2	10	12	22	0	0	0
Duluth, Minn.	—	3	3	6	0	0	0
Hudson River: Poughkeepsie, N. Y.	0.2	15	17	32	—	—	—
Illinois River:							
Peoria, Ill.	0.4	28	26	54	1	0	1
Grafton, Ill.	—	48	24	72	8	1	9
Kanawha River: Winfield Dam, W. Va.	—	34	11	45	0	0	0
Klamath River: Copco, Oreg.	—	31	22	53	0	0	0
Little Miami River: Cincinnati, Ohio	1.1	48	50	98	<1	0	<1
Merrimack River: Lowell, Mass.	[b] 0.7	19	24	43	0	0	0
Mississippi River:							
St. Paul, Minn.	0.9	18	31	49	0	1	1
Dubuque, Iowa	—	10	22	32	0	2	2
Burlington, Iowa	0.6	11	16	27	4	0	4
E. St. Louis, Ill.	—	36	34	70	0	1	1
Cape Girardeau, Mo.	0.8	22	26	48	0	2	2
West Memphis, Ark.	—	55	31	86	6	1	7
Delta, La.	[b] 0.4	148	29	177	—	—	—
New Orleans, La.	—	59	38	97	20	1	21
Vicksburg, Miss.	—	63	34	97	3	<1	3
Missouri River:							
Williston, N. Dak.	—	3	19	22	—	—	—
Bismarck, N. Dak.	—	<1	13	13	—	—	—
Yankton, S. Dak.	0.6	4	19	23	1	4	5
Omaha, Nebr.	—	3	28	31	1	2	3
St. Joseph, Mo.	—	11	26	37	0	5	5
Kansas City, Kan.	—	24	23	47	1	1	2
St. Louis, Mo.	1.4	33	40	73	2	2	4
Monongahela River: Pittsburgh, Pa.	0.4	12	15	27	1	<1	1
North Platte River: Henry, Nebr.	—	18	52	70	0	30	30
Ohio River:							
East Liverpool, Ohio	0.4	—	—	—	—	—	—
Huntington, W. Va.	—	18	14	32	0	0	0
Cincinnati, Ohio	—	19	15	34	1	0	1
Louisville, Ky.	0.4	18	17	35	1	0	1
Evansville, Ind.	—	16	17	33	3	0	3
Cairo, Ill.	1.1	—	—	—	—	—	—
Ouchita River: Bastrop, La.	—	48	66	114	<1	0	<1
Potomac River:							
Williamsport, Md.	—	14	16	30	0	0	0
Great Falls, Md.	—	14	28	42	—	—	—
Platte River: Plattsmouth, Nebr.	—	12	30	42	<1	8	8
Rainy River:							
International Falls, Minn.	—	4	16	20	0	0	0
Red River, South:							
Index, Ark.	—	87	54	141	3	1	4
Denison, Tex.	—	7	20	27	—	—	—
Alexandria, La.	1.0	84	28	112	13	1	14

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TABLE 1.—RADIOACTIVITY IN RAW SURFACE WATERS—Continued

[Average concentrations in μμc/liter]

Station	Quarter ending Sept. 30, 1961	December 1961					
	Strontium-90	Beta activity			Alpha activity		
	Total	Suspended	Dissolved	Total	Suspended	Dissolved	Total
Rio Grande River:							
Alamosa, Colo	[b] 0.4	—	—	—	—	—	—
Laredo, Tex	—	9	23	32	0	7	7
Brownsville, Tex	—	21	32	53	1	2	3
Roanoke River: John H. Kerr Reservoir and Dam, Va	—	10	11	21	0	0	0
Sabine River: Ruliff, Tex	—	33	38	71	—	—	—
San Juan River: Shiprock, N. Mex	—	5	38	43	1	13	14
St Lawrence River: Massena, N. Y	—	4	16	20	0	0	0
Schuylkill River: Philadelphia, Pa	—	25	30	55	2	1	3
Savannah River:							
Port Wentworth, Ga	0.4	18	27	45	0	0	0
North Augusta, S. C	—	10	10	20	0	0	0
Shenandoah River: Berryville, Va	—	21	25	46	<1	0	<1
Snake River:							
Wawawai, Wash	0.3	10	22	32	0	2	2
Payette, Idaho	—	10	25	35	0	3	3
South Platte River: Julesburg, Colo	0.7	9	67	76	2	36	38
Susquehanna River:							
Sayre, Pa	0.3	13	15	28	<1	<1	1
Conowingo, Md	0.3	11	25	36	0	0	0
Tennessee River:							
Pickwick Landing, Tenn	—	14	33	47	<1	0	<1
Chattanooga, Tenn	0.6	54	54	108	4	0	4
Bridgeport, Ala	0.7	15	50	65	0	0	0
Tombigbee River: Columbus, Miss	—	165	42	208	2	0	2
Truckee River: Farad, Calif	—	5	15	20	<1	<1	1
Yakima River: Richland, Wash	0.4	9	13	22	0	2	2
Yellowstone River: Sidney, Mont	—	3	21	24	—	—	—

[a] Dash denotes no sample received or no determination made.
[b] April-September strontium-90 data.

composite samples for the quarter ending in the month shown.

Additional information and data may be obtained from the following sources:

(1) *National Water Quality Network Annual Compilation of Data*, PHS Publication No. 663, Water Years 1957–58, 1958–59, 1959–60. Public Health Service, Division of Water Supply and Pollution Control, Washington 25, D. C.

(2) "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, at the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, pages 167–169.

(3) Setter, L. R., J. E. Regnier, and A. Diephaus, "Radioactivity of Surface Waters in the United States," *Journal of the American Water Works Association*, 51, 1377 (1959).

(4) Straub, C. P., L. R. Setter, A. Goldin, and P. F. Hallbach, "Strontium-90 in Surface Waters," *Journal of the American Water Works Association*, 52, 756 (1960).

(5) Setter, L. R., and S. L. Baker, "Radioactivity of Surface Waters in the United States," *Radiological Health Data*, Vol. I, No. 7 (1960).

(6) Straub, C. P., "Significance of Radioactivity Data," *Journal of the American Water Works Association*, 53, 704 (1961).

Monitoring of Water Supplies Around the Nevada Test Site

U.S. Atomic Energy Commission

By contract with the Atomic Energy Commission, the Public Health Service has conducted an offsite monitoring program around the Nevada Test Site (NTS) since 1955. This program includes sampling of air, water, and milk. Figures 1 and 2 summarize the gross beta measurements in water supplies located in the NTS offsite area for July–October 1961. The gross beta measurements are shown as numbers placed beside the sampling sites on

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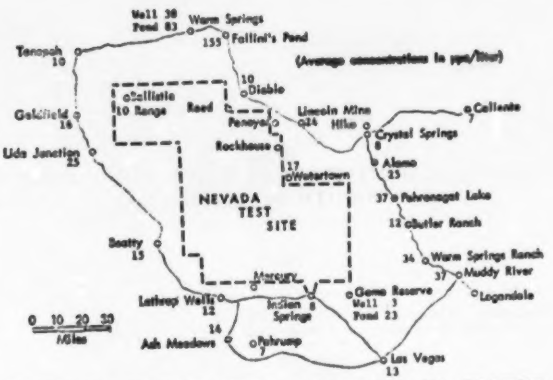
Well 30
Pond 83
Warm Springs
155 Fallini's Pond
Tonopah 10
(Average concentrations in μμc/liter)
10 Diablo
Ballistic
10 Range
Road
Goldfield 16
Lida Junction 25
Pahroc
Lincoln Mine
24
Hiko
Caliente 7
Crystal Springs 8
Rockhouse
17 Watertown
Alamo 25
NEVADA TEST SITE
37 Pahranagat Lake
12 Butler Ranch
Beatty 15
34 Warm Springs Ranch
37 Muddy River
Logandale
Mercury
Game Reserve
Well 3
Pond 23
Lathrop Wells 12
Indian Springs 8
0 10 20 30
Miles
14
Ash Meadows
Pahrump 7
Las Vegas 13

FIGURE 1.—GROSS BETA ACTIVITY IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE, JULY AND AUGUST 1961

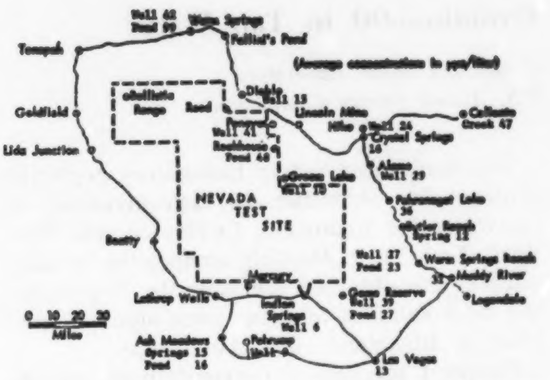
Well 42
Pond 99
Warm Springs
Fallini's Pond
Tonopah
(Average concentrations in μμc/liter)
Diablo
Well 15
Ballistic
Range
Road
Goldfield
Lincoln Mine
Hiko
Well 26
Caliente
Creek 47
Well 41
Rockhouse
Pond 48
Crystal Springs
16
Lida Junction
Alamo
Well 29
Groom Lake
Well 15
NEVADA TEST SITE
Pahranagat Lake
36
Butler Ranch
Spring 11
Beatty
Well 27
Pond 23
Warm Springs Ranch
32
Muddy River
Mercury
Logandale
Lathrop Wells
Indian Springs
Well 6
Game Reserve
Well 39
Pond 27
0 10 20 30
Miles
Ash Meadows
Springs 15
Pond 16
Pahrump
Well 6
Las Vegas
13

FIGURE 2.—GROSS BETA ACTIVITY IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE, SEPTEMBER AND OCTOBER 1961

figures 1 and 2. The lower limit of detection with the equipment used is about 10 μμc/liter.

All locations listed in table 1 are not sampled each month, but on a rotation basis so that in any given yearly period the necessary information is available to adequately describe the background radiation situation in the offsite area. During an operational period, intensive monitoring occurs in those areas affected. These data are published in special reports by the Atomic Energy Commission.

The highest gross beta concentration in water for July and August 1961 was 155 μμc/liter at Fallini's Pond on August 15. While this is higher than usual, it is still essentially background. The increase can probably be attributed to the comparatively heavy rains preceding the sample pickup. During the period September and October, the highest concentration was from the pool at Warm Springs on October 11, which was also essentially background.

Previous coverage in *Radiological Health Data:*

Period	*Issue*
November–December 1959	April 1960
January–April 1960	September 1960
May–June 1960	November 1960
July–August 1960	January 1961
September–December 1960	May 1961
January–February 1961	June 1961
March–June 1961	November 1961

TABLE 1.—DESCRIPTION OF WATER SAMPLING POINTS, NEVADA TEST SITE

Location	Source	Population served
Las Vegas	13 wells—650 to 1,250″ depth plus Lake Mead supply	40,000.
Game Reserve	400′ drilled well	20.
Indian Springs	600′ drilled well	Average 250.
Pahrump	75′ driven well	10-50.
Ash Meadows	Spring 25′ deep	8.
Lathrop Wells	3 wells—600′ deep	Average 15.
Beatty	Spring	550.
Lida Junction	125′ drilled well	2-10.
Goldfield	Spring	Average 200.
Tonopah	2 drilled wells—60′ depth	Average 1,500.
Warm Springs	Multiple springs—no improvement	10.
Diablo	Well	State Highway Station.
Lincoln Mine	2 driven wells	3.
Caliente	Springs	Average 10-12.
Crystal Springs	Free flowing spring	0.
Alamo	2 wells—50-67′ deep	Average 175.
Pahranagat Lake	Surface	Not used for domestic purposes.
Butler Ranch	Flowing spring	1.
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool.
Logandale	Drilled well	300.
Ballistic Range	Drilled well	10-15.

Strontium-90 in Tap Water[1]

Health and Safety Laboratory
U.S. Atomic Energy Commission

The Health and Safety Laboratory performs analyses for strontium-90 concentrations in tap water for Richmond, California, and New York, New York. Monthly composites of daily samples are obtained for analysis. Tap water has been sampled at New York since August 1954, at Richmond since April 1958.

Figure 1 presents the strontium-90 concentrations in tap water from 1958. Data prior to 1958 appear in "Environmental Contamination from Weapons Tests," *HASL-42A*, June 16, 1958. Table 1 presents third and fourth quarter monthly averages for 1961, and averages for 1959 and 1960.

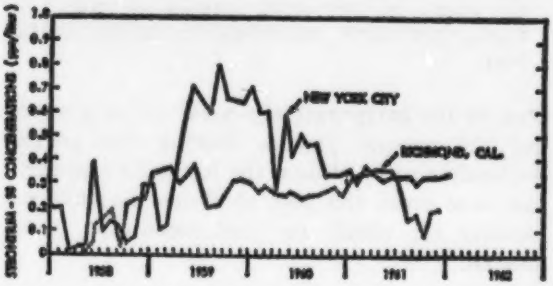

FIGURE 1.—STRONTIUM-90 CONCENTRATIONS IN TAP WATER

TABLE 1.—STRONTIUM-90 IN TAP WATER, THIRD AND FOURTH QUARTERS, 1961

Location	Month	Strontium-90 (μμc/liter)	$\frac{Sr^{89}}{Sr^{90}}$
Richmond, California (40 liters per sample)	Average 1959	0.29	
	Average 1960	0.26	
	July 1961	0.31	
	August	0.14	
	September	0.16	0.7
	October	0.08	0
	November	0.18	1.0
	December	0.19	7.4
New York, New York (100-200 liters per sample)	Average 1959	0.40	
	Average 1960	0.47	
	July 1961	0.30	
	August	0.34	
	September	0.19	0
	October	0.31	1.6
	November	0.30	7.2
	December	0.34	6.5

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[1] Data from *Quarterly Summary Report, HASL* 122, April 1, 1962.

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SECTION V.—OTHER DATA

External Gamma Activity

Division of Radiological Health, Public Health Service

Daily measurements of external gamma radiation are made at stations of the Radiation Surveillance Network to assure detection of any substantial deviations from normal background levels. Portable geiger-mueller survey instruments are used to obtain measurements at three feet above the ground surface. March 1962 data reported in table 1 are characteristic of individual station observations which in recent years have defined the range of normal background values.

TABLE 1.—EXTERNAL GAMMA ACTIVITY, MARCH 1962

Station location		Average (mr/hr)	Station location		Average (mr/hr)
City	State		City	State	
Adak	Alaska	0.01	Winchester	Mass	0.02
Anchorage	Alaska	0.01	Lansing	Mich	0.02
Attu	Alaska	0.01	Minneapolis	Minn	0.01
Cold Bay	Alaska	0.01	Jackson	Miss	0.01
Fairbanks	Alaska	0.01	Pascagoula	Miss	—
Juneau	Alaska	0.01	Jefferson City	Mo	0.01
Kodiak	Alaska	0.01	Helena	Mont	0.03
Nome	Alaska	0.01	Lincoln	Nebr	0.01
Point Barrow	Alaska	0.01	Trenton	N. J	0.02
St. Paul Island	Alaska	[a]—	Santa Fe	N. Mex	0.05
Phoenix	Ariz	0.02	Albany	N. Y	0.03
Little Rock	Ark	0.01	Buffalo	N. Y	0.01
Berkeley	Calif	0.01	New York	N. Y	—
Los Angeles	Calif	—	Gastonia	N. C	0.02
Denver	Colo	0.02	Bismarck	N. D	0.01
Hartford	Conn	0.01	Columbus	Ohio	0.01
Washington	D. C	0.02	Oklahoma City	Okla	0.02
Jacksonville	Fla	0.01	Ponca City	Okla	0.04
Miami	Fla	0.01	Portland	Oreg	0.02
Atlanta	Ga	0.02	Harrisburg	Pa	0.01
Agana	Guam	—	San Juan	P. R	—
Honolulu	Hawaii	0.05	Providence	R. I	0.02
Boise	Idaho	0.02	Columbia	S. C	0.02
Springfield	Ill	0.01	Pierre	S. D	0.02
Indianapolis	Ind	0.01	Nashville	Tenn	0.01
Iowa City	Iowa	0.01	Austin	Tex	0.01
Topeka	Kans	0.02	El Paso	Tex	0.02
Frankfort	Ky	0.01	Salt Lake City	Utah	0.02
New Orleans	La	0.02	Richmond	Va	0.01
Augusta	Maine	0.02	Seattle	Wash	0.02
Presque Isle	Maine	0.02	Madison	Wis	0.02
Baltimore	Md	0.02	Cheyenne	Wyo	0.02
Lawrence	Mass	0.02	Sundance	Wyo	—

[a] Dash indicates no data received.

Observed Concentrations of Iodine-131 in Human Thyroids

Division of Radiological Health, Public Health Service

Following the U.S.S.R. resumption of atmospheric nuclear testing on September 1, 1961, iodine–131 was first reported in the milk supply of the United States on September 19, 1961. It was first reported to the Division of Radiological Health to be present in human thyroids in New York City by Dr. M. Eisenbud of New York University, New York, N. Y., on October 10, 1961.*(1)*

A joint program was started with the following participants:

Armed Forces Institute of Pathology
Walter Reed Army Medical Center
Washington, D. C.

University of Arkansas
Little Rock, Arkansas

Tulane University
New Orleans, Louisiana

Division of Radiological Health
Public Health Service
Washington, D. C.

Between October 18, 1961 and February 1, 1962, the three participating medical centers supplied a total of 101 thyroids to the Radiological Health Laboratory at Rockville, Maryland. The intent was to examine thyroids of individuals who could have expected to have been taking a "normal diet" within two weeks of their death. Almost all were sudden deaths, usually from physical trauma.

Dissections were performed within a few hours after death by a pathologist and the specimens, with a dilute formalin preservative, were airmailed to the laboratory. The thyroids were then weighed and kept under refrigeration until counted. In some cases the thyroids were weighed and counted the same day as received; in others they were placed in a container and counted the following day. The gamma emissions of the specimens were counted for 100 minutes on a 4" x 4" sodium iodide (thallium) crystal and recorded by a pulse height analyser. The counts were simultaneously recorded on a print out and also on punched tape. The print out was used for the calculation of iodine–131 present in the thyroid specimen.

The assumption made in the calculation of the amount of iodine–131 present in thyroids was that identical counting conditions are found when counting a solution in a one ounce bottle. This assumption contained two factors, the geometry factor which was visually comparable and the absorption factor which would seem to be comparable since the density of the thyroid is approximately one. The counts considered to be due to iodine–131 were those found in the energy range of 0.3 Mev to 0.42 Mev and yet greater then the background in this energy region. Under these conditions the efficiency for counting iodine–131 was calculated to be 5.8 percent. Thus the equation for the amount of iodine per gram of thyroid is as follows:

$$\mu\mu c\ I^{131}/gm = \frac{(\text{Counts due to } I^{131})}{(2.22\ dpm/\mu\mu c)\ (0.058)\ (\text{time of count})\ (\text{gm of thyroid})}$$

Iodine–131 content determined at time of counting was then extrapolated back to time of death using the half life of eight days. The data is presented in table 1.

REFERENCE

(1) Eisenbud, M., Y. Mochizuki, A. S. Goldin, and G. R. Laurer, "Iodine–131 Dose from Soviet Nuclear Tests," Science, Vol. 136, No. 3514, pp 370–374 (May 4, 1962).

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TABLE 1.—IODINE-131 CONCENTRATIONS IN HUMAN MALE THYROIDS OCTOBER 1961–JANUARY 1962

Date of death	Location	Age (years)	Total thyroid weight (grams)	Iodine-131 (μμc/gm thyroid)
October 18	Louisiana	47	8.8	[a] ND
October 21	Unknown	28	11.3	ND
October 23	Germany	21	15.8	[b] 70
October 24	Alaska	27	30.5	21
October 24	Germany	19	15.4	ND
October 25	Louisiana	66	17.9	ND
October 25	Puerto Rico	26	11.3	ND
October 25	Unknown	31	20.3	ND
October 26	Germany	25	28	ND
October 27	California	5	3.28	30
October 28	Washington	29	14.9	730
October 28	Germany	23	13.1	20
October 29	Germany	24	25.4	ND
October 29	Korea	22	10.8	ND
October 30	Louisiana	52	16.8	8
October 31	Korea	42	26	ND
October 31	Korea	21	18	ND
November 1	Germany	19	23.7	ND
November 1-15	Unknown	—	14.1	ND
November 1-15	Unknown	—	18.4	ND
November 1-15	Unknown	—	20.7	ND
November 1-15	Unknown	—	21.7	ND
November 1-15	Unknown	—	19.5	ND
November 1-15	Unknown	—	18.3	ND
November 1-15	Unknown	—	20.1	ND
November 1-15	Unknown	—	20.0	ND
November 1-15	Unknown	—	11.2	ND
November 1-15	Unknown	—	21.0	ND
November 1-15	Unknown	—	21.0	2
November 2	Korea	19	13	ND
November 2	Germany	44	23.8	ND
November 3	Germany	Adult	15.1	2
November 3	Japan	37	17.7	2
November 5	Germany	32	30	5
November 6	Arkansas	3 months	2.5	ND
November 6	Germany	20	18	12
November 8	Unknown	33	23.8	ND
November 10	Arkansas	27	22.5	2
November 10	Unknown	—	14	3
November 10	Unknown	21	28.8	ND
November 10	Unknown	24	13.6	10
November 11	Unknown	26	20.5	ND
November 12	Germany	20	21.2	ND
November 12	Germany	41	23.6	ND
November 13	Colorado	32	18.6	ND
November 13	Germany	41	15.6	ND
November 13	Unknown	25	18	7
November 13	Unknown	5	3.8	5
November 13	Unknown	6 months	2	ND
November 13	Germany	19	14.0	ND
November 13	Unknown	20	16.6	ND
November 13	Spain	26	14.1	4
November 13	Spain	22	18.2	3
November 19	Okinawa	59	15.4	9
November 25	Germany	26	24.5	ND
November 29	Unknown	50	8.2	ND
November 30	Korea	Adult	14.9	ND
November 30	Korea	Adult	32.2	ND
November 30	Okinawa	19	9.9	ND
December 1	Germany	22	15.5	2
December 3	Colorado	18	15.2	8
December 3	Germany	23	14.6	4
December 3	Europe	1½	3.5	ND
December 3	Europe	40	27.5	ND
December 9	Pacific	44	30.2	2
December 9	Pacific	40	11.7	ND
December 10	Korea	28	24.0	2
December 11	Korea	23	21.7	2
December 11	Korea	39	12.6	ND
December 11	Unknown	31	13.6	ND
December 11	Washington	—	15.1	ND
December 21	Germany	25	34.0	2
December 28	Germany	36	23.5	ND
January 1-7	Japan	20	13.5	ND
January 3	Germany	26	25.2	ND
January 3	Germany	—	7.9	ND
January 3	Unknown	37	14.0	ND
January 3	Germany	20	25.4	2
January 3	Unknown	4	3.4	ND
January 3	Unknown	47	37.5	ND
January 4	Korea	41	10.9	ND
January 4	Unknown	23	19.9	ND
January 5	Germany	41	37.3	ND
January 6	Germany	41	26.2	ND
January 7	Puerto Rico	23	23.3	ND
January 8	Germany	30	17.0	ND
January 9	Korea	28	28.3	ND
January 9	Korea	22	35.7	2
January 9	Korea	Adult	22.0	2
January 10	Germany	31	20.2	2
January 18	Germany	21	23.7	ND
January 20	Japan	8	7.7	ND
January 23	Germany	19	13.4	ND
January 23	Germany	21	18.5	ND
January 25	Germany	11 months	2.1	[c] ND
January 26	Germany	48	13.6	ND
January 28	Korea	54	18.5	ND

[a] ND indicates concentration was non-detectable. Non-detectable for most samples was about 5 μμc/gm.
[b] Inquiry underway.
[c] Female.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission receives from its contractors quarterly reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant perimeter surveys are required.

Various summaries of the environmental radioactivity data for 18 AEC installations have appeared in *Radiological Health Data* since November 1960. Summaries follow for Brookhaven National Laboratory, Mound Laboratory, and National Reactor Testing Station, covering the third and fourth quarters of 1961.

The measured concentration of a radio-

TABLE 1.—SELECTED ENVIRONMENTAL VALUES PERTAINING TO AEC INSTALLATION REPORTS IN THIS SUBSECTION

Line no.	Radionuclide or mixture of radionuclides	Environmental MPC's	
		Water ($\mu\mu c$/liter)	Air ($\mu\mu c/m^3$)
1	If Sr^{90}, I^{129}, Pb^{210}, Po^{210}, Ra^{223}, Ra^{226}, Ra^{228}, Pa^{231}, and Th-nat are not present[a]	2,000	—
2	If Sr^{90}, Pb^{210}, Ra^{226}, Ra^{228} are not present[a]	600	—
3	If Ra^{226}, Ra^{228} are not present[a]	100	—
4	Mixture of unidentified nuclides	10	0.04
5	If α emitters and Ac^{227} are not present[a]	—	1.0
6	If α emitters and Pb^{210}, Ac^{227}, Ra^{228}, and Pu^{241} are not present[a]	—	10.0
7	If α emitters and Sr^{90}, I^{129}, Pb^{210}, Ac^{227}, Ra^{228}, Pa^{230}, Pu^{241}, and Bk^{249} are not present[a]	—	100
8	Hydrogen-3 (tritium)	3,000,000	200,000
9	Iodine-131	2,000	200
10	Plutonium-239	5,000	0.06
11	Polonium-210	700	20
12	Strontium-90	100	10

[a] "Not present" implies that the concentration of the nuclide is small compared with its appropriate MPC. According to recent AEC regulation (*Federal Register*, Title 10, Part 20, August 9, 1961), a group of nuclides may be considered not present if the ratio of each nuclide to its appropriate MPC is equal to or less than 1/10 and if the sum of these ratios for the group in question is equal to or less than 1/4.

nuclide in air and water may be compared with the Maximum Permissible Concentration (MPC) of that nuclide as recommended by the National Committee on Radiation Protection and Measurement (NCRP). For the environment near an AEC installation, the applicable MPC's are one-tenth of the occupational MPC values for continuous exposure given in National Bureau of Standards "Handbook 69."

To avoid any possible misunderstandings in the use of the term "Maximum Permissible Concentrations," the Federal Radiation Council (FRC) has recommended the term "Radioactivity Concentration Guide (RCG) for the use of Federal Agencies. Although FRC has not published a table of RCG values, several AEC installations such as National Reactor Testing Station, have adopted FRC nomenclature but use the NCRP published values. For a more detailed description of the meaning and use of the RCG, the reader is referred to FRC Report No. 2.[1]

For purposes of clarity and perspective, a few of the applicable environmental MPC values for nuclides or mixtures of unknown nuclides are listed in table 1. Such values are intended as guides only. For further clarification, "Handbook 69" should be consulted.

The establishment of MPC's does not imply that each nuclide may be permitted to be present at 100% of its MPC concentration. If the concentration of each nuclide is expressed in terms of percent of its MPC, the sum of all the percent values should not exceed 100%.

In the following reports, the use of nonspecific terms such as "total activity," "total alpha," and "gross beta" do not in themselves suggest any one MPC value. Often, when concentrations are low a laboratory will assign an MPC value that is more restrictive than necessary. This avoids the more costly isotopic tests necessary to justify a less restrictive value. References in table 1 will be made to designate the appropriate MPC's reported by the laboratories.

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[1] Federal Radiation Council Report No. 2, "Background Material for the Development of Radiation Protection Standards," Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price 20 cents.

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Brookhaven National Laboratory

Associated Universities, Inc.
Upton, New York

Third and Fourth Quarters 1961

The Brookhaven National Laboratory (BNL) operations affect the environmental levels of radiation in two ways: (1) by discharge of coolant air from the graphite research reactor, and (2) by the discharge of low level radioactive liquid wastes into a small stream that forms one of the head waters of the Peconic River.

Air Monitoring

The radioactivity in the discharge coolant air is almost entirely that of argon–41, a beta-gamma emitter. Because the most critical exposure to argon–41 is that of external gamma, the monitoring is performed by measuring the dose-rate in milliroentgens per week (mr/wk) rather than the concentration in air. The environmental maximum permissible dose recommended by NCRP is 0.5 r/yr (10 mr/wk) above natural background, averaged over a one year period.

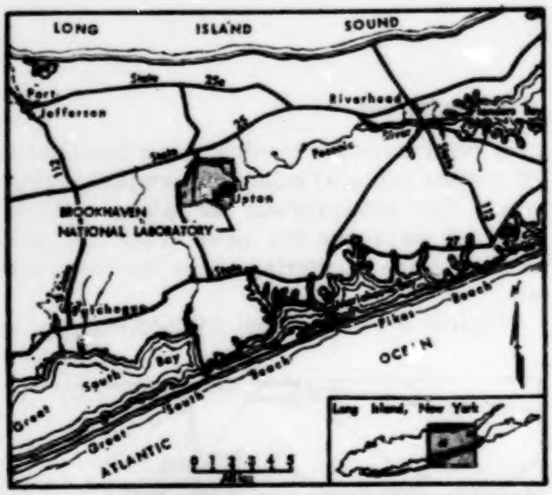
LONG
ISLAND
SOUND
Port Jefferson
State 25a
Riverhead
25
Peconic
River
Upton
BROOKHAVEN NATIONAL LABORATORY
27
112
Patchogue
South
Bay
Great
South
Beach
Pikes
Beach
OCEAN
ATLANTIC
Long Island, New York
0 1 2 3 4 5

FIGURE 1.—BROOKHAVEN NATIONAL LABORATORY AND SURROUNDING AREA

Table 2 presents the average external gamma dose rates measured at the four stations shown in figure 2.

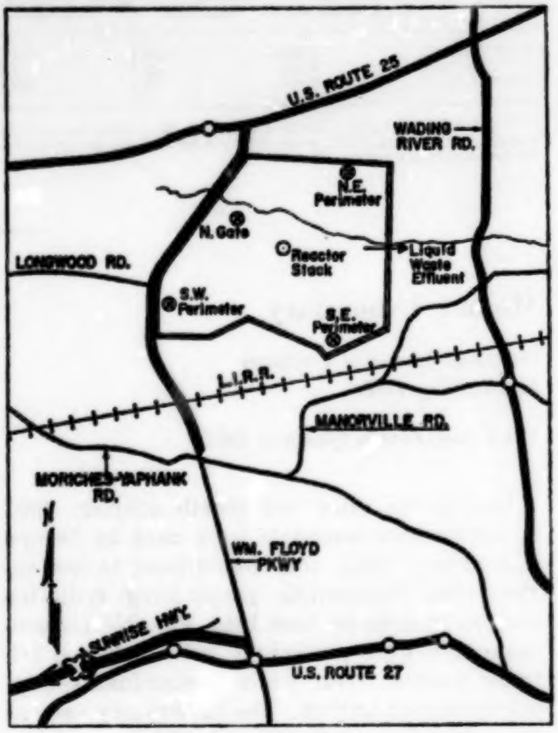
U.S. ROUTE 25
WADING RIVER RD.
N.E. Perimeter
N. Gate
Reactor Stack
Liquid Waste Effluent
LONGWOOD RD.
S.W. Perimeter
S.E. Perimeter
L.I.R.R.
MANORVILLE RD.
MORICHES-YAPHANK RD.
WM. FLOYD PKWY
SUNRISE HWY.
U.S. ROUTE 27

FIGURE 2.—BROOKHAVEN NATIONAL LABORATORY MONITORING STATIONS LOCATIONS

TABLE 2.—EXTERNAL GAMMA LEVELS AT BNL SITE BOUNDARY, 1961

[Average dose rates in mr/week]

Period-1961	North gate	Southwest perimeter	Southeast perimeter	Northeast perimeter
Gamma from laboratory operations:[1]				
First quarter[2]	0.30	0.43	0.90	0.40
Second quarter[2]	0.66	0.44	0.47	1.55
Third quarter	0.66	0.73	0.28	0.92
Fourth quarter	0.38	0.35	0.77	0.46
Calendar year	0.50	0.49	0.60	0.83
Dose rate from undisturbed background:				
Third quarter	2.09	2.07	2.05	1.81
Fourth quarter	2.57	2.33	2.51	2.74

[1] Gamma dose from laboratory operation is due almost entirely to argon-41 from the reactor cooling air.

[2] The first and second quarters have been included here to amend the data reported in January 1962 *Radiological Health Data*, page 24, table 2, which erroneously showed the peak weekly averages instead of the quarterly averages.

Table 3.—GROSS BETA ACTIVITY IN LIQUID WASTE EFFLUENT, BNL, 1961

Period—1961	Average effluent flow rate (million gallons/day)	Average beta concentration[1] (μμc/liter)	Total beta activity discharged (millicuries)
Third quarter	1.094	180	64.8
Fourth quarter	0.705	140	31.7
Calendar year	0.898	170	102.9

[1] The MPC used by the plant for this stream is 300 μμc/liter based on the knowledge that less than 20% of the activity is Sr^{90} and that no appreciable amount of radium is present (see table 1).

Water Monitoring

The BNL liquid waste effluent is monitored for gross beta concentrations at the site boundary. Table 3 presents the average concentration together with the total activity released as determined by using known effluent flow rates.

Previous coverage in *Radiological Health Data*

Period	Issue:
1959 and first quarter 1960	December 1960
Second quarter 1960	February 1961
Third and fourth quarters 1960	June 1961
First and second quarters 1961	January 1962

Mound Laboratory

Monsanto Chemical Company
Miamisburg, Ohio

Third and Fourth Quarters 1961

During the third and fourth quarters 1961 no radioactive materials were used by Mound Laboratory (ML) that contributed to the environment measurable penetrating radiation such as gamma or hard beta. Possible air contaminants were plutonium, polonium, and tritium; possible river water contaminants were polonium and tritium. The Laboratory uses as its guides the environmental MPC's as determined from NBS "Handbook 69" (see table 1).

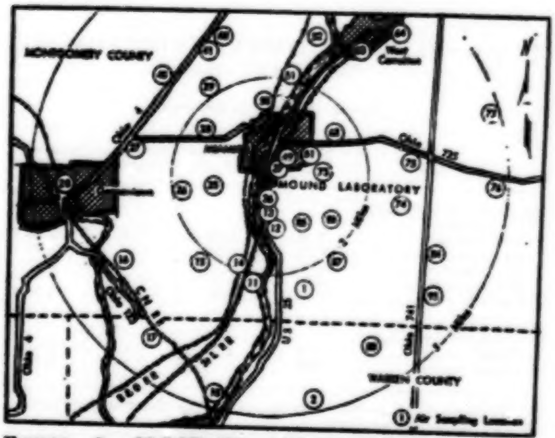

Figure 3.—CLOSE-IN AIR SAMPLING LOCATIONS, MOUND LABORATORY

Air Monitoring

A continuous air monitor for measurement of tritium and particulate air sampling equipment for measurement of alpha activity mounted on a one ton panel truck are used in the routine monitoring of the environmental air.

Figures 3 and 4 show 95 locations up to

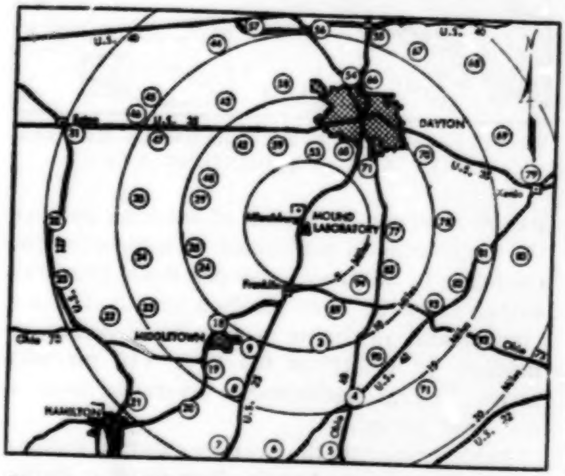

Figure 4.—DISTANT AIR SAMPLING LOCATIONS, MOUND LABORATORY

TABLE 4.—DISTANCE EFFECT ON LONG-LIVED ALPHA CONCENTRATIONS IN AIR, ML, 1961

Sampling locations zone (distance in miles from laboratory)	Third quarter 1961		Fourth quarter 1961	
	No. of samples	Average concentration ($\mu\mu c/m^3$)	No. of samples	Average concentration ($\mu\mu c/m^3$)
0–2	26	0.015	27	0.024
2–5	39	0.010	41	0.012
5–10	22	0.020	25	0.008
10–15	30	0.013	29	0.021
15–20	38	0.011	34	0.051

20 miles from the laboratory at which air samples are taken. The selection of sampling sites depends on the wind direction on the days that samples are collected. Samples are collected downwind from the plant according to routes drawn up for the different wind directions. It is quite likely that not all sites will be sampled during any one quarter.

A total of 310 samples were taken for determination of tritium in air during the third and fourth quarters, 1961. In all cases the tritium concentration was below the minimum level of detection.

Monitoring for possible polonium and plutonium released to the environment is accomplished by determination of long-lived gross alpha on filter paper samples. Counting was done in a low background proportional counter after sufficient time had elapsed after collection to permit the decay of short-lived daughter products of radon and thoron. The average alpha concentrations in air at different distances from the Laboratory are given in table 4. An upwind-downwind comparison is shown in table 5.

If all the alpha activity were assumed to be polonium it would be about 0.05% of the MPC for polonium as given in table 1. However, polonium effluent stack monitoring indicated that no detectable polonium should be found in the environment due to the operations of Mound Laboratory.

If the alpha activity were assumed to be all plutonium, it would amount to a much more significant 15 percent of the MPC for plutonium. Again the stack monitoring results are quite meaningful. The average concentration of plutonium in the air discharged from the plutonium stack was well within environmental limits. For this reason, and the fact that the air is discharged to the environment from the 200-foot stack at high velocity yielding appreciable dilution, it is seen that the plutonium operations have contributed an insignificant burden to the radioactivity normally present in the atmosphere. It is also pointed out that

TABLE 5.—WIND EFFECT ON LONG-LIVED ALPHA CONCENTRATIONS IN AIR, ML, 1961

Direction from laboratory relative to wind	Third quarter		Fourth quarter	
	No. of samples	Alpha ($\mu\mu c/m^3$)	No. of samples	Alpha ($\mu\mu c/m^3$)
Upwind	24	0.009	24	0.016
Downwind	155	0.012	159	0.025

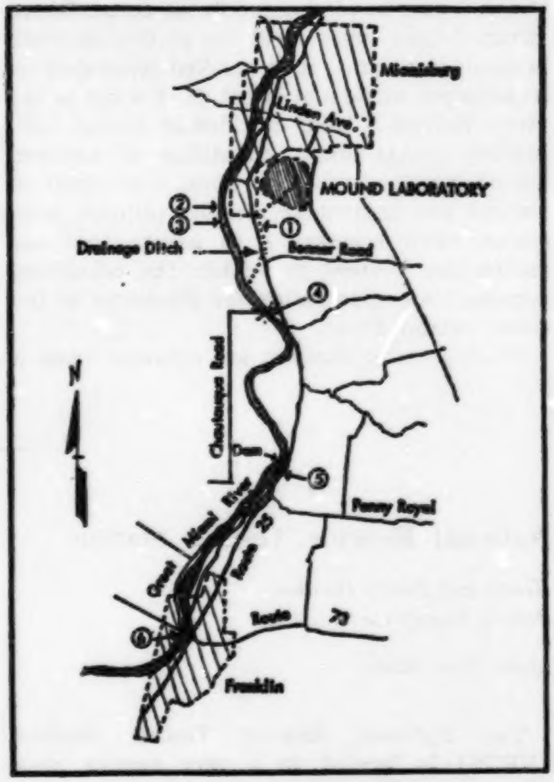

FIGURE 5.—WATER SAMPLING LOCATIONS IN GREAT MIAMI RIVER, MOUND LABORATORY

TABLE 6.—OFF-SITE WATER MONITORING FOR POLONIUM AND TRITIUM, ML

[Average concentrations in $\mu\mu c$/liter]

Station code no. (see figure 5)	Third quarter 1961				Fourth quarter 1961			
	Tritium		Polonium		Tritium		Polonium	
	No. of samples	Concentration	No. of samples	Concentration	No. of samples	Concentration	No. of samples	Concentration
1	9	3,700,000	0	—	11	630,000	0	—
2	9	2,600,000	10	9.4	11	180,000	11	9.36
3	0	—	10	0.36	0	—	11	0.16
4	9	1,400,000	10	2.53	11	270,000	11	0.32
5	0	—	10	0.54	0	—	11	0.64
6	0	—	10	0.72	0	—	11	ND[b]
Others[a]	0	—	0	—	0	—	5	ND

[a] Single samples were collected at five downstream locations between Franklin and Elizabethtown, Ohio.
[b] ND—No detectable activity.

the natural long-lived alpha concentration in air in southwestern Ohio is in the range of and frequently exceeds the MPC for plutonium.

Water Monitoring

Liquid radioactive waste materials from polonium work at the Laboratory are processed in a special waste disposal plant designed to reduce radioactivity to a concentration level at which it may be discharged to the Great Miami River. Liquid waste from the plutonium work is small in volume. It is handled separately as a packaged waste and is not discharged to the river. Helium-3 being purified at Mound Laboratory yields small quantities of tritium. Liquid wastes from this work, also small in volume are treated separately (diluted with water when necessary) to assure that the radioactive content is within the maximum permissible concentration for discharge to the Great Miami River.

Weekly water samples are collected from a drainage ditch and five locations along the Great Miami River as shown in figure 5. The drainage ditch carries away all storm sewer water and liquid tritium wastes from the plant site. Sampling location number 2 is located at the point of discharge of the laboratory effluent to the Great Miami River. Number 6 is five miles downstream from the effluent discharge. Additional single downstream samples were collected at five locations (beyond the limits of the map in figure 5) during the first quarter.

All of the river samples are analyzed for polonium concentration. The drainage ditch samples and some of the river samples are analysed for tritium. Average concentrations of polonium and tritium are given in table 6.

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	November 1960
Second and third quarters 1960	March 1961
Fourth quarter 1960	August 1961
First and second quarters 1961	January 1962

National Reactor Testing Station

Health and Safety Division
Atomic Energy Commission

Idaho Falls, Idaho

The National Reactor Testing Station (NRTS) is located in a very remote area which, in a large measure, permits controlled releases of radioactivity from the projects with a minimum risk to the environs. The Atomic Energy Commission is responsible for holding environmental radioactivity levels below the Radiation Protection Guides (RPG) recom-

TABLE 7.—ENVIRONMENTAL MONITORING PROGRAM DATA, NRTS, 1961

Type of sample and units	Third quarter 1961		Fourth quarter 1961		Calendar year		RCG's and RPG's (See table 1)
	Number of samples	Average activity	Number of samples	Average activity	Number of samples	Average activity	
Off-site underground water ($\mu\mu c$/liter)	58 56	α: < 4 β: < 190 H^3 <6000	33 32	α: < 4 β: < 200 H^3 <4000	177 88	α: < 4 β: < 200 H^3 <6000	10 3,000 1,000,000
On-site production well water ($\mu\mu c$/liter)	203 93	α: < 4 β: < 190 H^3 <6000	198 180	α: < 4 β: < 200 H^3 <5000	789 273	α: < 3.5 β: < 200 H^3 <5000	100 30,000 30,000,000
Off-site air filters ($\mu\mu c/m^3$)	178	β: 2	163	β: 23	653	β: 7.1	100
Perimeter jack rabbit bones[a] ($\mu\mu c$ Sr^{90}/g Ca)	8	10	11	9	45	11	None
Off-site jack rabbit bones ($\mu\mu c$ Sr^{90}/g Ca)	13	8	[illegible]	12	85	10	None
Off-site milk[b] ($\mu\mu c$ I^{131}/liter)	36	< 90	33	< 70	117	< 100	2,000 [b]100
Area monitoring badges (mrem)	23	(Total for quarter) γ < 20 β < 20	25	(Total for quarter) γ < 20 β < 20	118	(Total for year) γ < 130 β < 100	500/year 3,000/year

[a] The reporting of strontium-90 in jack rabbit bones lags the collection of the samples by one quarter year.

[b] During the third quarter 1961, the RCG for milk was changed from 2,000 to 100 $\mu\mu c$/liter and the analytical detection limit lowered from 200 to 50 $\mu\mu c$/liter

mended by the Federal Radiation Council (FRC). The monitoring program is one of the safeguards employed. Descriptions and discussion of the monitoring network procedures have been presented in earlier issues. Table 7 presents the environmental monitoring data for the third and fourth quarters of 1961 and the calendar year averages (see figure 6 for sampling locations).

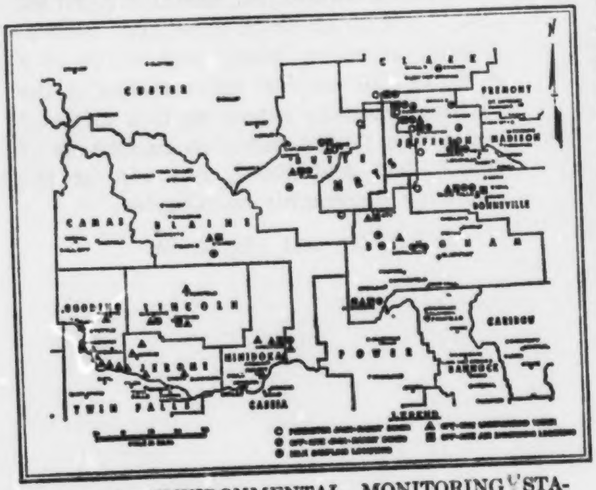

FIGURE 6.—ENVIRONMENTAL MONITORING STATIONS, NATIONAL REACTOR TESTING STATION

In conformance with the Federal Radiation Council's recommendation to the President that the guide value for the iodine-131 intake be established at 100 $\mu\mu c$/day averaged over a period of one year (FRC Report No. 2), and assuming that the consumption of milk will approximate one liter per child per day, the radiation protection guide (RCG) used by NRTS for milk was changed during the third quarter 1961 from 2000 to 100 $\mu\mu c$/liter. This necessitated a refining of the analytical procedures whereby the lower limit of detection was changed from 200 to 50 $\mu\mu c$/liter of milk.

Previous coverage in *Radiological Health Data*

Period	*Issue*
1959 and first quarter 1960	November 1960
Second quarter 1960	February 1961
Third and fourth quarters 1960	May 1961
First and second quarters 1961	January 1962

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Reported Nuclear Detonations

May 1962

Since the resumption of nuclear weapons testing in September 1961, summary data have been presented on testing activities during the month preceding publication. Starting with the October 1961 issue, all known Soviet test detonations were numbered consecutively, and in the December issue, consecutive numbering of United States detonations was started. Occasional French tests which have been made since 1960 were not previously numbered, but for convenience in referring to them, numbers have been applied, and the May 1, 1962 French test is reported as the fifth in this series. May 1962 information on all known Nuclear test detonations is summarized in the table below.

Two of the Pacific tests conducted in the vicinity of Christmas Island as part of Operation DOMINIC during the past month were reported as noteworthy: the May 6 launching from a Polaris submarine of a missile carrying a nuclear warhead, and the May 11 underwater nuclear detonation conducted in the Eastern Pacific Ocean, several hundred miles from the closest land areas.

"DOMINIC test series" has been defined as that series of nuclear tests to be conducted in 1962 by the Atomic Energy Commission and the Department of Defense in the areas surrounding Christmas Island and Johnston Island, within the following danger areas:

(1) Effective April 15, 1962 until a date to be announced, an area bounded by a line joining these coordinates:

06° 50′N.,	149° 20′W
08° 10′S.,	149° 20′W
08° 10′S.,	162° 40′W
06° 50′N.,	162° 40′W

(2) Effective April 30, 1962 until a date to be announced, an area bounded by a line joining these coordinates:

06° 50′N.,	147° 20′W
02° 50′N.,	147° 20′W
02° 50′N.,	149° 20′W
06° 50′N.,	149° 20′W

(3) That area established, effective April 30, 1962, until a date to be announced, encompassing Johnston Island and which is a circle of 470 nautical miles radius at the surface gradually extending to a circle of 700 nautical miles radius at an altitude of 30,000 feet and above, centered at the following geographic coordinates:

16° 45′N., and 169° 31′W

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NUCLEAR TEST DETONATIONS REPORTED DURING MAY 1962

Country	Test number	Location	Date	Yield range*	Type of test
France	5	Sahara	May 1	Not announced	Underground
United States	36	Christmas Island	May 2	Low megaton	Atmospheric
	37	Christmas Island	May 4	Intermediate	Atmospheric
	38	Christmas Island	May 6	Not announced	Nuclear warhead in missile launched from Polaris submarine
	39	Nevada Test Site	May 7	Low	Underground
	40	Christmas Island	May 8	Intermediate	Atmospheric
	41	Christmas Island	May 9	Intermediate	Atmospheric
	42	Christmas Island	May 11	Intermediate	Atmospheric
	43	Christmas Island	May 11	Low	Underwater
	44	Nevada Test Site	May 12	Intermediate	Underground
	45	Christmas Island	May 12	Intermediate	Atmospheric
	46	Christmas Island	May 14	Intermediate	Atmospheric
	47	Christmas Island	May 19	Intermediate	Atmospheric
	48	Nevada Test Site	May 19	Low	Underground
	49	Nevada Test Site	May 25	Low	Underground
	50	Christmas Island	May 25	Low	Atmospheric
	51	Christmas Island	May 27	Intermediate	Atmospheric

* Low yield range has been announced as meaning about a nominal (20 kiloton) yield, and intermediate yield meaning the range between nominal and one megaton.

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